THE SOCIAL CONSTRUCTION OF ADULTHOOD:

MENARCHE AND MOTHERHOOD

A Dissertation

by

SHERRY L. MCKIBBEN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2003

Major Subject: Sociology

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ABSTRACT

The Social Construction of Adulthood:

Menarche and Motherhood.

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Demographic and sociological theories usually do not incorporate biological variable into their explanations. This dissertation addresses this void by examining the influence of age at menarche on age at first birth, the event of a first birth, and the number of children ever born (CEB). I expand on Demographic Transition theory by incorporating biology as one of the effects of modernization that has an effect on reducing fertility. Age at menarche decreases as a society modernizes.

I use data from the 1995 Survey of Family Growth, Cycle V for the U.S., and the 1997 China Survey of Population and Reproductive Health. I further stratify the data into five race/ethnic groups: Chinese Han, Chinese minorities, U.S. Non-Hispanic Whites, U.S. Non-Hispanic Blacks, and U.S. Hispanics of Mexican origin. I use four different statistical methods to model my dependent

variables: Ordinary Least Squares Regression, Cox Proportional Hazard Analysis, Poisson Regression, and Negative Binominal Regression.

My first major finding is that the younger a woman is when reaching menarche, the younger she will be when giving birth to her first child. Second, the younger a woman is when reaching menarche, the longer the duration to a first birth and the less likely she is to experience a first birth. These two results are consistent in all the groups I analyze. Third, the younger a woman when reaching menarche, the fewer children she will produce. The U.S. Mexican-Origin women are an exception in this final outcome.

It is well known that as a society modernizes, age at menarche decreases. Analyses in my dissertation indicate that as women's ages at menarche decrease, their ages at giving birth to the first child also decrease, but their chances of having a first birth also decrease and their waiting time for having the first birth increases. Also, fertility will decline as age at menarche declines.

To my husband, David

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CHAPTER I

INTRODUCTION

All cultures have markers or rites of passage that indicate when members are ready to move from one phase to the next phase of privileges and responsibilities. These markers are typically chronological age, governmental policies, and religious doctrine or traditions; they are usually reinforced through socialization and norms. Privileges, such as dating, marriage and parenthood are granted to an individual as he or she passes from and through the socially constructed phases of childhood and adolescence, and into adulthood. These privileges are based on the perceived maturity of the individual and are often considered individual decisions. When to allow ones child to begin dating, when to get married, when to start a family, and how many children are desirable are decisions left to the individual. Or are they?

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This dissertation follows the style of the *American Sociological Review.*

All societies have inputs into these decisions. Society deems a person “ready” for the next level of responsibility. The question then is what is the basis of the judgments, and how are they reinforced through socialization? The importance a society places on these markers may well affect future behaviors. For instance, many cultures believe that when a girl reaches menarche, she is transformed into a woman.

This biological function, menarche, has traditionally been the basis of marking the passage from one phase in life to the next. Menarche signals the time when a female first becomes fecund and has the biological potential for motherhood. Marriage and/or motherhood allow her to become a full member of her social world. Ceremonies marking this phase of “womanhood” vary from culture to culture (Stattin and Magnusson 1990), but virtually all cultures have at one time or another used this marker as the timing of entry into womanhood. Upper class white families in western cultures have “Coming Out” parties. These are typically after the girl’s sixteenth birthday. Mexican-Origin families have the Quinceanera (Serrato 2003), which is held after the girl’s fifteenth birthday. Historically, these “celebrations” coincided with a girl reaching menarche and signaled to all single men that the girl had become a “woman”.

Many sociologists and demographers have sought to uncover social explanations for behavior, while minimizing, if not discounting biological factors. There are exceptions (the work of Richard Udry provides good examples), but most demographic and sociological theories concentrate primarily on social explanations. With the exception of the proximate determinants paradigm, fertility theories such as demographic transition, wealth flows, political economy, household economy, and others, pay little if any attention to biological predictors.

The predominant fertility paradigms in the demographic literature are demographic transition, wealth flows, political economy, and proximate determinant. Each offers valuable insights about the determinants of fertility, but each has flaws and each omits menarche as a variable.

Demographic Transition Theory began with Notestein (1945) and was refined with results from the Princeton Fertility Project. It states that for most of human history, fertility was fairly high and constant, but mortality rates fluctuated. This fluctuation in mortality rates kept population growth relatively stagnant. With industrialization and technological advancements, mortality rates decreased while fertility rates remained high, leading to a rapid increase in population growth. Fertility rates gradually decreased. This transition from high birth rates and high mortality rates to low birth rates and low mortality rates is the demographic transition (Knodel and van de Walle 1986). One major shortcoming of this theory is it does not explore the reasons for the changes in mortality and why parents would automatically decide that more children were not valuable. This theory does not examine structural factors that affect fertility.

Wealth Flows Theory postulates that high or low fertility is a result of the direction of the wealth flows, from child to parent, or parent to child. When it is economically sound to produce many children so the parents can reap the economic benefits, fertility rates will be high. An example is agrarian societies where children provide labor for the farm. The parents need many children to assist in the farm chores. But, when the economic benefits transfer from parent to child, fertility rates will be low. This is exemplified in an urban society where children do not work and the parents must provide all of the economic security for the children. Therefore, when the wealth changes from flowing from child to parent, fertility rates will decrease (Caldwell 1982). The major flaw of this theory is that it only examines fertility as an economic benefit or liability and as an individual decision. Outside forces or structural influences have little input into the fertility decisions.

Political Economy Theory examines the decline of fertility from the standpoint of the structures in society that influence individual decisions. The theory examines the global, national, or regional forces that affect individual decisions. This is a trickle down approach to fertility from the macro to the micro (Greenhalgh 1990). While this theory incorporates structural factors into fertility decisions, it fails to include biological variables.

The Proximate Determinants theory is the only dominant theory that includes a biological component. This theory integrates many of the variables that are related to fertility into seven major determinants. The first four are the principle determents and include marriage, contraceptive use, induced abortion, and postpartum infecundabilty. The last three, the secondary determinants, are waiting time to conception, intrauterine mortality and permanent sterility (Bongaarts and Potter 1983). Biological processes are prominent in this paradigm, but it fails to examine the onset of fecundity and how this is a cultural marker that determines whether a women is “ready” for the first proximate determinant, marriage.

While there are numerous other theories that attempt to explain fertility rates such as ecological, feminist, and diffusion, they all fail to include the one major event that must proceed fertility, menarche. This is an important oversight in fertility theories because menarche and how girls’ social worlds react to this biological function should have an influence on the timing of her future fertility behavior. With modernization, the average age at menarche has decreased. This is due largely to better nutrition and healthier lifestyles (Frisch 1988; Wahrenforf 1993). In the United States, as with other Northern European countries, the average age at menarche has decreased by about two years in the past one hundred years (Pollard 1994). As the age at menarche decreases, the timing of future fertility behavior should also decrease. Decreasing age at menarche may also have larger social and economic consequences that lie outside the individual woman or even beyond her immediate social world.

Therefore, in this dissertation, I will investigate whether a biological factor such as age at menarche has an independent effect on fertility and fertility related behavior. The three central goals of my dissertation are: 1) to model the relationship between a woman's age at menarche and age when giving birth to her first child; 2) to model the relationship the duration between a woman's age at menarche and giving birth to her first child; and 3), to model the relationship between a woman's age at menarche on the number of children she will produce.

This dissertation will explore the relationships between age at menarche and age at first birth and the hazard of a first birth, and the number of children ever born (CEB) for Chinese and for American women. If the woman's first birth and CEB behaviors are entirely social decisions, her age at menarche should have no statistically significant effect.

In Chapter II, I review the relevant literature about the importance of a woman's age at menarche on her sexual behavior. There has been a very limited amount of literature using age at menarche as a predictor variable, and much of the time it is used as a secondary independent variable. It is seldom used as the primary variable to examine fertility.

In Chapter III, I will discuss the mechanisms of human reproduction. This will include detailed information about the process of menarche and ovulation. I will include a discussion about the consequences of early or late menarche. Finally, I will put forth my hypotheses.

In Chapter IV, I discuss the data and methods I will use. Two different data sets from two different countries (China and the United States) will be used. I will further divide the data by race and ethnic groups for a total of five different subgroups for analysis. The advantage of using data from two different cultures allows me to examine the interaction of social and biological effects within and between different cultures. I will use three different types of regression models, Ordinary Least Squares (OLS), Hazard Analysis, and Poisson Regression. This chapter will give an operationalization and description of the dependent variables and independent variables. The dependent variables will be reviewed in each chapter.

Chapter V will examine the relationship between age at menarche and the woman’s age at giving birth to her first child using ordinary least squares (OLS) regression.

Chapter VI will examine the relationship between age at menarche and the transition to motherhood. The dependent variable will be operationalize as a hazard and Cox Proportional Hazard analysis will be used to examine this relationship.

Chapter VII tests the effects of age at menarche on the number of Children Ever Born (CEB). Poisson regression is used in this analysis because CEB is a count variable and left skewed.

Chapter VIII discusses the conclusions and further research needed. The implications of this research will be discussed and how it could be expanded to include other models and variables. There are several ways one can operationalize age at menarche and these are explored. Other methods that could, and should, be used to gain a more accurate picture of menarche’s effects on fertility and fertility behaviors will be recommended for future research.

CHAPTER II

LITERATURE REVIEW

This chapter will discuss the previous studies that have utilized menarche as an independent variable. While a literature search using menarche and any of the fertility behaviors that are the focus of this dissertation will yield literally hundreds of articles, very few use menarche as a variable. Most mentions of menarche are in two contexts, one as the beginning of fecundity and a requirement for childbearing, and two, as the final indication that a girl has completed puberty. Therefore, the literature using age at menarche is limited and not very extensive. I will organize it around four different themes, age at first intercourse, age at marriage, age at first birth, and CEB.

AGE AT FIRST INTERCOURSE

Sexual coupling, or intercourse, is one of the behaviors that are reserved for “mature adults”. The literature disagrees about the influence of menarche on intercourse, in that some research has found a positive and significant relationship, while others have found no significant relationship after controlling for relevant social factors. But rooted in biology, “the biological theory is based on the simple proposition that androgenic (“male”) hormones, which increase at puberty for both sexes, increase the predisposition to engage in sexual behavior” (Udry 1988: 710), while sociological theory is based on the principle that social structures can overcome any biological predisposition.

Udry and Cliquet (1982) found that a female’s age at first intercourse is correlated with her age at menarche. Using data from six different sources and four different countries, they found that cross cultural differences in age at menarche and the amount of social controls did not negate the effect of menarche on age at first sexual intercourse, first marriage or first birth. The mean ages at menarche varied from 12.64 years for U.S. Whites to 14.25 years for Malaysian Chinese. The strict religious practices of the Muslims in Pakistan did not alter the effect of menarche on the ages at marriage nor first birth. This study found a mean age of about 8 years between menarche and first intercourse for women in Belgium and the U.S. The conclusion of this paper is as follows:

> The differences in timing of reproductive events are due to some more or less universal social processes by which the time of onset of menstruation and the rate of development of physical sexual maturity are picked up as social information on the basis of which social processes differentially propel women with different biological timing into mating and reproductive activity. (60)

This then would indicate that the transition to the adult responsibilities of marriage and motherhood are rooted in a biological process, menarche, which is deemed an important marker in almost all cultures. While correlations between menarche and first intercourse, first marriage, and first birth were found, regression analysis was only conducted for the Malaysian Malays and Malaysian Chinese. These both indicated a significant relationship ($p<0.01$) between menarche and first birth. Since menarche seems to be related to first sexual intercourse, regardless of social factors, the biological motivation contributing to the desire for sexual intercourse must be examined.

Udry, Talbert, and Morris (1986) established a link between sexual desire or libido and hormones. They found that a change in hormonal levels in both males and females changes their sexual motivation. This is important because hormones are the cause of pubertal development, and this study indicates that hormones biologically influence one’s desire for sexual activity. One problem with this study is its limited sample size. Only 78 cases were used; this sample was drawn from one mid-sized town, all the cases were white, and they collected blood samples to test for hormones for a very limited time.

Engaging in any type of sexual behavior by adolescents is usually viewed as deviant behavior in most sociological studies. Udry and Billy (1987) questioned the motivation of some adolescents to engage in premarital coitus while other refrain. They found that social controls of family and peers did not explain the transition to coitus for white males and black females, but pubertal development was highly significant to black females’ transition. White females were more influenced by social controls when abstaining from engaging in coitus, but hormones played a significant role in their thinking about sexual behaviors. Sexual attractiveness was not significant in any of the groups. While this study corrected some of the concerns of limited cases and time by including over one thousand cases and using follow up surveys at two-year intervals, a better statistical method to use in this study rather than Logistic Regression would have been Hazard Analysis because the authors were looking at the transition to coitus, which is a time varying outcome.

Some research suggests that race may play a roll in the link between menarche and sexual behavior such as dating and first intercourse. Presser (1978) used a sample of 541 Black and White women aged 15-29 from three boroughs in New York City. This study uses correlations and found that the link between menarche and timing of dating and age at first sexual intercourse is strong for black women, but almost non-existent for white women after controlling for social factors. But, she found that age at menarche does not seem to influence the timing of the first birth.

Zabin and colleagues (1986) also found a positive association between age at menarche and age at first sexual intercourse for black females. They found that the younger a black female was when reaching menarche, the younger she would be when experiencing her first sexual encounter. Using life tables to predicted the probability of engaging in sexual intercourse, they found that if a female reaches menarche before age 12, she has a probability of 0.55 of engaging in sexual intercourse before she reaches 15 years old, as opposed to those females who are 14 and older when they reach menarche who have a probability of only 0.32.

The sample was of sufficient size (1,134), but the survey was limited to only two schools in Baltimore, Maryland. This study is may not be representative of the whole. But, it does lend support that menarche has a positive and significant effect on age at first coitus regardless of social controls.

Social control theory holds the premise that without social controls, everyone would engage in deviant behavior. Therefore, social factors should overcome biological predisposition. Udry (1988) further examined hormonal predisposition toward sexual behavior but also included social controls. Using the traditional social factors such as family, age and SES, he found that 32 percent of the variance in female sexual behavior is explained by these social factors. The biological model, which includes seven different hormones, explains 14 percent of the variance. Udry found that the best model is one in which social and biological factors are combined. And the biosocial model explains 28 percent of variance for females. But, the hormone variable becomes insignificant for girls who participate in sports. This indicates that the social control of involvement is strong enough to overcome any biological predisposition. The interaction effects for girls show that, sometimes, social controls can overcome hormonal effects and they also reveal that some of the effects were spurious.

Models that examine the relationship between pubertal development and friend’s sexual involvement paint the clearest picture of the interaction between biological and social factors (Smith, Udry, and Morris, 1985). And they show a clear link between sexual development and fertility.

While much of the research about initial coitus does not include any biological variables, the above studies clearly indicate that menarche is a significant indicator that a female is “ready” to engage in sexual activities and regardless of most social influences, will engage in sexual coupling.

AGES AT FIRST MARRIAGE AND FIRST BIRTH

The links between age at menarche and age at marriage and age at first birth have been demonstrated in cross-cultural studies using United States, Belgium, and several Asian data sets (see above discussion of Udry and Cliquet 1982). A direct relationship exists between age at menarche and age at marriage. As the age at menarche increases, the age at marriage also increases and the age when a female gives birth to her first child also increases.

Chowdhury and colleagues (1977) examine the relationship between malnutrition, age at menarche, and age at marriage in rural Bangladesh. After 1971, the socioeconomic conditions deteriorated in this country and afforded these researchers the necessary conditions to establish a positive association between nutrition and age at menarche. Using data collected in thirteen villages from personal interviews with 1,155 girls from ten to twenty years old, they found that the average age at menarche and the average age at first marriage increased since 1961. A correlation exists between the increase in age at menarche and age at marriage. Also, those girls who had not reached menarche were less likely to be married than those who had reached menarche. These findings do not differ for Muslim or Hindu girls. The researchers draw the conclusion that:

> Since both age at menarche and age at marriage have increased, it may be expected that fertility among females age 15-19 will decrease in the future if this pattern continues (324).

Using longitudinal data collected since 1935, Sandler and associates (1984) extended this research to the United States. They found significant relationships between age at menarche and both age at marriage and age at first birth. As age of menarche increases, age at marriage and age at first birth also increase. They also found a relationship between age at menarche and fertility, but it disappeared when controlling for other factors such as education and residency.

Riley and colleagues (2001) examined the duration between age at menarche and age at marriage and first birth and found that after controlling for social variables, age at menarche had no effect on either marriage or first birth. These findings were derived from two sources of data that are questionable. The Tremin Trust data were collected from three cohorts of only white women who were attending the University of Minnesota. The first cohort attended from 1935 to 1939, the second cohort from 1961-1965, and the third attended through 1980. The birth years are from 1900 to 1950. These women are not representative of the population. The second data set only included women from the cohort born in 1900-1910. Marriage patterns have evolved and changed and other research utilizes more current cohorts. Second, the duration to first birth is measured from first marriage. The risk period for a birth does not begin at marriage, but at menarche. Also, controlling for age at birth should negate most other age related variables because menarche is also age related. Therefore, these results are questionable.

In trying to explain teenage fertility changes, Manlove and colleagues (2000) used life-course analysis utilizing the 1995 cycle of the National Survey of Family Growth to examine the differences between three cohorts of women and their hazard of experiencing a first birth. The sample included 4,883 women. Age at menarche is significant for the first two cohorts in predicting the hazard of experiencing a first birth for sexually active teenagers. Unfortunately, there is little discussion about the effects of age at menarche. This study used this variable only as a control for timing of first intercourse.

CHILDREN EVER BORN

Researchers who have examined the relationship between menarche and fertility have found that the older a woman at menarche, the less her fertility.

In a cross-cultural study using data from the World Fertility Study for nine developing countries, evidence shows a substantial difference in fecundity among women in developing countries. Later age at marriage has been shown to have a positive, nonlinear effect on fecundity. The amount of time a woman is fecund contributes to her ability to have children. Thus, effecting fertility. This finding is based on the first birth interval and uses many variables to control for cultural differences. It shows that social factors play a significant role in fecundity. Women with higher education who are urban residents have a higher fecundity, but lower fertility than their counterparts (Kallan and Udry 1986). Therefore, socioeconomic status plays an important role in the number of children a woman will produce, regardless of other factors. But, fecundity will play a role in the number of children a woman is capable of giving birth to over her life course.

Allman (1982) analyzed the fertility of Haitian women. Using the Haiti Fertility Survey from 1977, he found that late unions were much more important in decreasing fertility than late menarche; indeed, when controlling for social factors, age at menarche had no significant effect on fertility. He found that among Haitian women, education about contraceptive methods and formal unions were the two most important factors determining the number of children a woman had. But, his conclusion is that late age at menarche plays a role in reducing fertility. One problem is the assumption that childbearing takes place within a marital union. While this may be the case in some societies, Haiti has a considerable amount of women of childbearing years who are not engaged in any marital union. Therefore, it would be prudent to include all women in the study.

Turning to Puerto Rico, Morales Del Valle and Crespo (1982) found no relationship between age at menarche and children ever born. Using survey data from 1996 interviews of 2,012 women aged 15-54, they found that after controlling for cohort status, the relationship between menarche and age at first marriage and number of live births, no trends were found, even for women marrying below 17 years old. Economic differences were found to play a more significant role in determining CEB.

Varea, Bernis, and Elizondo (1993) used menstrual age as a determinant of age at marriage, age at first birth and completed fertility. Menstrual age is the difference between age at menarche and age at marriage. This in itself poses a problem in that they make the assumption that childbearing does not occur until after marriage. But, using data from 496 married women age 25 to 54 living in Marrakech, Morocco, they found that menstrual age, age at menarche, and age at marriage were significantly and positively correlated. Late maturers tended to marry later, but their menstrual age was shorter. This means that they did not wait as long to marry as those women who reached menarche early. They also found that as menstrual age increased, the number of live births also decreased. This means that if a woman has a longer duration from menarche to marriage, she will have fewer children.

CONCLUSION

The literature is undecided as to whether menarche has an independent affect on fertility behaviors involve marriage and childbearing. Some suggest that menarche does have a significant effect after controlling for social factors, while others find evidence that it does not. But, menarche is a prerequisite for fertility, and the behaviors associated with fertility should be related to it.

The consensus among demographers and bio-demographers is that age of menarche has no significant effect on the number of children ever born and any effect it might have is negated by social factors. In fact, age at marriage seems to be the most important variable that negates menarche’s affect. But, few researchers include single women in their studies and since marriage is not necessarily a prerequisite for childbearing this could be a major deficiency in the studies. And, despite the very limited amount of research on this topic, the line of reasoning that a late age at menarche will lead to a later age at marriage, later age at first birth, and reduce fertility has remained dominant in the demographic and sociological literature.

In the next chapter, I will discuss the mechanism of human reproduction and put forth some hypotheses about how the complicated process could affect fertility. I will also put forth the hypotheses for my dissertation.

CHAPTER III

HUMAN REPRODUCTION

This chapter will discuss the biological mechanisms involved in human reproduction. I will then proceed to a discussion of the biological reasoning underlying my hypotheses. And finally, I will put forth my three hypotheses.

BIOLOGY OF REPRODUCTION

I will discuss the biology responsible for the onset of menarche, ovulation, and menopause. Each of these plays a part in the amount of time a woman is fecund and is available for reproduction. This is considered a woman's reproductive life span and many researchers use life history to examine the different functions associated with fertility.

A detailed discussion of female human reproduction is in order to fully comprehend the complex mechanisms responsible for the two events that indicate the beginning and ending of a woman's fecund period: menarche and menopause. These events are two distinct and seemingly unrelated events in a woman's reproductive life. Therefore, each will be discussed separately and then the biology of ovulation will be addressed.

Menarche

Menarche is thought to signal the time when a female becomes capable of reproduction, but changes have been occurring in her body for some time prior to this “marker” and a period of non-ovulatory menses occurs after the onset of menarche. Primary sex characteristics will begin to develop in the girl when she is between 8 and 16 years of age. This is when a girl begins to see an increase in muscle strength, body fat, the development of pubic hair and the development of breasts (Golub 1983: 31). These changes begin as a result of hormonal changes brought on by the initial activation of the gonadotropin-releasing hormone (GnRH) pulse regulator. The cause of the activation is not known which presents a problem when explaining the onset of menarche. Activation of the GnHR can be seen in the increase in luteinizing hormone (LH) secretion during sleep. It then follows a pulsate pattern. Activation seems to begin in the Central Nervous System (CNS) and is independent of the ovary (Wood 1994; 402).

After the onset of menarche, a woman is not automatically ovulating each cycle. A period of subfecundity occurs (Wood 1994; 401). Some studies indicate that women with earlier menarche increase in ovarian function much earlier than their late menarche counterparts (Ellison 2001). Ellison (2001) reports that in three different cultures, increased levels of ovarian steroid production (necessary for ovulation) in young maturers are higher than late maturers and appears to be consistent over a woman's lifetime, meaning that those who reach menarche early produce more steroids than those who reach menarche later; this increased production is consistent over the reproductive life course. Evidence from other studies indicates that the time from first ovulation may be shorter for women with late menarche compared to those with shorter menarche (Wood 1994; Foster et al. 1986). This would mean that the ability to become pregnant following menarche would be sooner for women reaching menarche late rather than early. It also suggests that women with later menarche tend to catch up with women with early menarche in terms of fertility performance (Foster et al. 1986).

Another reason for this period of subfecundity may be evolutionary. A woman who is still maturing (in her early teens) needs her energies for her own development. A fetus requires many of the reserves available for development. As a female matures, her biological capacity to reproduce increases as she matures into her twenties. It is then a cost/benefit trade-off between the reproduction and her own survival. Postponing reproduction increases the woman's odds of future reproduction and the survival of the fetus (Ellison 2001; 226). But, if the body is already mature because it has a later menarche, ovulation should begin sooner and the body more able to sustain pregnancy.

Fetal loss is more likely to occur after thirty or thirty-five and in the teenage years (Wood 1994; 250). Each pregnancy lengthens the birth interval and causes a reduction in fertility. Each one of these adds gestation days until the next fertile period. Also, the development of each dominant follicle take approximately three cycles to become capable of fertilization; this is a loss of one complete cycle (Wood 1994; 73, 244). So, a younger woman is more likely to experience fetal loss even if she is unaware she has conceived. This would add time to her next possible conception, and the younger a woman is at menarche; the more likely she is to experience more fetal loss. And "early menarche may predispose [women] toward a higher risk of fetal loss, at least during the first two or three pregnancies” (Wood 1994; 252).

Menopause

Menopause is the end of a woman’s reproductive life. Unlike menarche, menopause is not an event that can be determined until well after it has happened. A woman is postmenopausal “if she has experienced at lease 12 months since her last menses in the absence of a known pregnancy” (Wood 1994; 401).

The cause of menopause is the depletion of primordial follicles. Typically, the female fetus will develop around 7 million follicles, but when she reaches menarche, only about seventy-five percent of her present pool, or around 300,000 follicles, remain (Ellison 2001; Zonneveld et al. 2001). This is actually only about thirty-three percent of the follicles that originally developed. This preset number of follicles begins depleting before birth until the time when only about 1,000, or about two percent, remain in each ovary, which is when peri-menopause begins (Wood 1994; O’Connor et al. 1998; Ellison 2001). Shortly thereafter, virtually none are present at menopause. These follicles are necessary for fertility because only a select few will develop into the oocyte.

Therefore, menarche is initiated by the “turning on” of the GnHR, and menopause results due to the depletion of follicles. Based on this fact, one would surmise that the events are mutually exclusive, but hormonal interactions that begin at menarche (or as we will demonstrate shortly thereafter) contribute to the depletion of the follicular pool through the ovulation cycle. And this in itself may be what determines a woman’s potential fertility.

BIOLOGICAL REASONING

The ovarian cycle is a complex mixture of brain function, nerves and hormones. Each follicle contains its own germ cell, and there are two courses that each follicle can follow, ovulation or atresia. Atresia is the more common path, but what determines whether a follicle will grow or atresia is not clearly understood. Some evidence suggests that it is a purely random occurrence with each follicle having the same random chance of developing and growing during each cycle which “implies a negative exponential decline in the number of primary follicles remaining in the ovary at any age” (Wood 1994; 130). But others indicate that after some follicular growth less than "20 percent are healthy in terms [of]… oocyte viability" (McNatty 1982; 7). Also, as follicles deplete, the ratio between those that are primordial and growing decreases from 50 to 1 at puberty to 3 to 1 in women between 39 and 45 years of age (Talbert 1978; 64). This indicates that the chance of having a healthy, growing follicle declines with age. Atresia is thought to be caused by the loss of activity in granulosal aromatase. This is one of the enzymes required to convert androgens to estrogen in the follicles (Wood 1994; 131).

Ovulation involves not only the ovary but also the hypothalamus and pituitary gland. The hypothalamus links several parts of the brain and acts as a conductor to coordinate impulses between the central nervous system and the endocrine system much of which is between the hypothalamus and the pituitary gland. One of the most important communications comes in the form of the gonadotropin-releasing hormone (GnRH) that we previously demonstrated is important for the onset of menarche (Wood 1994; 125). This then acts within the pituitary gland to trigger the release of luteinizing hormone (LH) and follicle stimulating-hormone (FSH), which are carried to the ovaries. The LH and FSH stimulate the release of other hormones and “the growth and differentiation of the follicle cells” (Wood 1994; 126). Ovulation is thus dependent on the interplay between the hypothalamus, pituitary gland and the ovary. The follicles begin to grow at the start of the menstruation cycle until ovulation takes place (Zonneveld et al. 2001).

Survival of the fittest suggests that those follicles that are most desirable for ovulation will be chosen first to develop and grow; since each ovarian cycle depletes the follicle pool, the result will be a declining number of viable follicles. This decline means that a female’s fecundity is not constant over her life. Each female has a peak period, which then declines with age. Weinstein and her colleagues (1990) found the peak age to be about twenty-five years. Other research has estimated the peak to be between 20 and 25 (Jain 1969; Larsen and Vaupel 1993). Since age at menarche varies among women in a population, I agree with Ellison (2001; 225) that there is “a steady, age-related increase in fecundity over the decade or so after menarche” and then a slight decline until the thirties and forties when the decline increases rapidly (Ellison 2001; 220). Therefore, controlling for socioeconomic status, the earlier a female reaches her menarche, the earlier she should reach her peak fecund age.

The length of the menstrual cycle also is a consideration for fertility performance. During the teen years, cycles tend to have higher levels of testosterone and other androgens. This suggests that the follicle in adolescences is smaller and not as likely to grow to maturity. This smaller preovulatory follicle results in lower rates of estradiol production, which may result in a diminished ability to be fertilized (Ellison 2001). The difference in hormonal levels affects the mean number of days of they cycle. Evidence indicates that older women, either menstrual or chronological, will have a shorter mean menstrual cycle than younger women. This should be reflected in the difference in hormones found in the different ages of the women (Wood 1994). This would also indicate that older women would have more chances to become pregnant and bear children because over their lifetime, they will have more cycles. The mean cycle length is varies from twenty-five to thirty-seven days (Wood 1994; 133). This twelve day period means that the a woman who cycles every twenty-five days will have 14.6 cycles per year, while a woman who cycles every thirty-seven days will have

9.9 cycles per year. Over a lifetime of approximately thirty year of cycles, the first woman will have 438 cycles and the second woman will have only 297. Thus, the woman who cycles are fewer days apart will have more chances to conceive and produce children.

The number of menstrual cycles a woman has over her lifetime does vary by society. It is different for women in natural fertility societies than those in controlled fertility societies. Women in natural fertility societies proceed though a cycle of ovulation, pregnancy, lactation, subfecundity, waiting time to conceive, and ovulation again. Throughout her lifetime, a woman will only have about fifty menstrual cycles whereas a woman in a controlled fertility society may have around 355 (Wood 1994; 141). This excessive number of cycles may be physically detrimental to the women (Short 1976, as cited in Wood 1994). As the number of cycles increase, the less capable the woman may be to carry the fetus, resulting in fetal loss (see above discussion about fetal loss and its causes).

As I demonstrated above, menarche is a result of the initiation of the GnRH and menopause is the result of depletion of the follicles, but the process of ovulation involves both the GnRH and follicles. So, the ovulation process interconnects both events. Ovulation requires that a selected follicle grow until the release of the oocyle and one could surmise that the selected follicle should be the one that has the highest chance of insemination. Therefore, the women who have reach menarche early are “ready” early to produce a child, but it also makes sense to suggest that women who reach their peak fecund period before the socially and normatively desirable childbearing years, i.e., in the early 20s, are likely to “waste” a great deal of their follicles that are most suitable for ovulation and thus not have the potential to produce as many children compared to females who reach their peak later. Females who reach their age at menarche early have more menstrual cycles, and each one reduces the number of potentially viable follicles remaining, while those with a later age at menarche will retain their viable follicles for a longer period into their lifecycles. Even though follicle depletion is a continuous biological function, those that are capable of becoming fertile may be limited. The female whose menarche is delayed until her late teens may well have more viable follicles available, and should be able to produce more children, other things equal.

So, several different processes are operating at the same time to influence the timing and possibility of fertility and each could individually or in combination determine the number of children a woman has in her lifetime. First, the time from menarche to ovulation appears to be shorter for women with later ages at menarche, leading to a shorter subfecund period and waiting time to conceive. Second, the mean menstrual cycle length may be shorter for women who reach menarche later, which would lead to more cycles over the lifetime and more opportunities to conceive. Third, women in their teen years are more likely to suffer fetal loss than women in their twenties leading to an increase in the number of days between conception and birth, adding days to the gestation of the fetus. So if a woman reaches menarche early, the time it takes to produce a live birth will increase as her gestational days increase. Fourth, in controlled fertility societies like the U.S. and China, women experience an increase in number of menstrual cycles, which could lead to an increased health risk for the women. Early menarche women experience more cycles than later menarche women; therefore, the later the age when reaching menarche, the more likely the woman will be better fit physically to carry the fetus to term. And fifth, the number of viable follicles that could grow and develop drops with each cycle, which means that the more cycles the woman has before she is “ready” to produce a child, the more of the “best” follicles she “wastes”. Therefore, early menarche “wastes” more follicles that are potentially her “best”.

HYPOTHESES

Therefore, I put forth the following hypotheses that will be tested in the following chapters:

H_1 - age of menarche is positively related to age at first birth. The older a female’s age of menarche, the older she will be at giving birth to her first child.

H_2 – The older a female’s age of menarche, the later she will experience the hazard of her first child’s birth.

H_3 – Age of menarche is positively related to CEB. The later her age of menarche, the more children she will have.

The next chapter will discuss my data, methods, and dependent and independent variables that will be used in the subsequent chapters.

CHAPTER IV

DATA AND METHODS

In this chapter I will discuss my data and the methods I will be using. First, I will discuss my data, and then I will discuss the three different methods, Ordinary Least Squares (OLS), Cox Proportional Hazards, and Poisson regression I am using. Then I will operationalize and discuss my dependent and independent variables used in each of the analyses.

DATA

I am using two sets of data in my dissertation. The first is from China. These data are from China's Sample Survey of Population and Reproductive Health (SSPRH), which was conducted in late 1997 (State Family Planning Commission of China 1998). The SSPRH collected data on the health and reproductive behavior of a nationally representative sample of 15,213 married and unmarried women between the ages of 15 and 49. Data on the woman's age at her first birth and CEB, however, were only gathered for currently or ever married women. My analysis is thus restricted to the 11,818 currently married or ever married women in the sample. This should not pose any problems though because childbearing is almost universally restricted to married couples in China. The data are further stratified into two groups, one for ever married Han women consisting of 10,879 women, and one for women who belong to minority nationalities consisting of 936 women that have higher fertility than the Han due to fertility differences between majority and minority women (Poston 1993). Manchu and Korean women are thus excluded from this second analysis.

My second set of data is for U.S. women. These data are from the 1995 National Survey of Family Growth, Cycle V (National Center for Health Statistics 1995). The data are based on personal interviews conducted in the homes of a national sample of 10,847 females between the ages of 14 and 44 in the civilian, non-institutionalized population in the United States. With this data set I further stratify the women into ethnic groups of Non-Hispanic White, Non-Hispanic Black and Hispanic of Mexican-Origin.

An exact comparison between the United States and China is not possible. First, the data from China include many fewer social variables. The U.S. data allow for controls of numerous variables of socialization that are absent in the China data, such as religion and parental influences. Second, the China data are limited to married females, while the U.S. data include all females. However my main interest is ascertaining in both populations whether there is an independent and significant effect of age at menarche on the dependent variables.

While an exact comparison is not possible, using data from two distinct cultures should enable me to examine the effects of the biological variable between and within the cultural contexts of China and the U.S. I will be able to examine the strength of the influence of menarche between the two countries and for the different groups in each country.

One of the main objections of many social scientists to including biological variables in investigating causes of behavior is the concern that “if a behavior has a biological foundation, it cannot also have social foundations” (Udry 1995: 348). This may be true of a purely biological theory, but my dissertation research is based on biosocial theory. Therefore, I am concerned with the biological variable’s impact on the predispositions of individuals to experience a first birth and their subsequent fertility within and between two different environments, China and the U.S. In other words, using these two different countries should allow me “to examine the interactions of environment and biological individual attributes to explain individual behavior” (Udry 1995: 352).

Social theories assume that individuals have choices, albeit these choices may be forced upon the individuals. Biology, on the other hand, removes individual choice. But, the environment to which the individual is exposed should exert some amount of social control. The amount of control a society exerts will influence how strong the biological predisposition will influence behavior. Udry (1995) states:

> When the social structure and the structure of social controls allow easy options on behaviors that are biologically based, then biological factors will influence the choice of options, and biologically based variance in behavior occurs. When options are few and some options are difficult to choose, biologically based variance shrinks to the vanishing point. (352-3)

Thus, in a country such as China where social control is strong in relation to fertility, and the social institutions necessary to enforce the controls are fairly well established, the effects of menarche should be less than in the U.S. where no formal social institutions or social structures are present to control fertility or its related behaviors. Also, within China, the effect of menarche should be stronger for minority women than for Han women because the one-child policy is more strictly enforced among Han women. In the U.S., the effects of menarche should be less for Non-Hispanic White women than for Non-Hispanic Black and Mexican-Origin women because the social stigma of early childbirth and having more than two children is stronger for Whites women than for minority women.

Using multiple data sources and then stratifying them into subsets of race/ethnic groups allows me to examine the interaction affects of biology and social environment.

Next, I will discuss the three different methods I will be using in my dissertation.

METHODS

I will be discussing the three different methods I am using in my dissertation. In Chapter V, I am using Ordinary Least Squares (OLS) regression to estimate the effect of menarche on a woman’s age at her first birth. In Chapter VI, I am using Cox Proportional Hazard analysis to estimate the effect of menarche on a woman’s transition to her first birth. And, in Chapter VII, I am using Poisson regression to estimate the effect of menarche on the number of Children Ever Born (CEB) to a woman. Each of these methods will be discussed.

Ordinary Least Squares

The first method I am using is Ordinary Least Square (OLS) regression. It is based on a linear regression line, which assumes a linear relationship between one dependent variable and one or more independent variables. Multiple regression is one of the most popular methods used in the social sciences. It makes it possible to use many explanatory variables while controlling for each other (Allison 1999). The formula for multiple linear regression is:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + \cdots b_k X_k + e$$

Where *Y* is the dependent variable; *a* is the intercept; *b* is the slope; *X* is the independent variable; *e* is error term.

In order to use OLS, several assumptions must be meet. First, the relationship between the dependent variable needs to be a linear function of the independent variables. Second is the basic assumption that the dependent variable is quantitative, unbounded, and continuous, and the independent variables are either quantitative or dichotomous and any errors occur in “a random, unsystematic fashion” (Allison 1999; 14); therefore, the data are unbiased. Third is efficiency, the data must have standard errors that are as small as possible. Fourth, there is not perfect collinearity between two or more of the independent variables. Fifth, we assume the mean of the error term is zero. Sixth, the error term is homoscedastic, i.e., variance of the error term does not depend on the independent variables. Seventh, the error term for one independent variable is uncorrelated with the error term for all other independent variables. And finally, eighth, the error term has a normal distribution. If all of these assumptions have been meet, OLS is the most appropriate regression to use in the analysis (Allison 1999).

OLS is the most appropriate method to use for the first models because my dependent variable (age at first birth) and independent variables meet these assumptions.

Hazard Analysis

The second method I am using is hazard analysis. This method is also referred to as event-history analysis and survival analysis because one is examining “the patterns and correlates of the occurrences of events" (Yamaguchi 1991; 1). Hazard analysis was first developed in the biomedical sciences. The scientists were interested in examining the effect of different treatments on their subjects' ability to survive the event of death. Therefore, they were interested in two outcomes, the event (death) and the time period until the event occurred (the risk period).

One major advantage of hazard analysis over regression is that hazard analysis has two distinct features. One is time-varying explanatory variables and the other is censoring.

Variance of time variables is one of the major advantages of hazard analysis and assumptions are made in regards to how time operates. One important assumption in hazard analysis is determining when one enters the risk period for succumbing to the event. This assumption can be either explicit or implicit (Yamaguchi 1991). An example of an explicit assumption is the onset of cancer. We do know that children are not likely to become ill with certain kinds of cancer, but we do not know exactly when the risk does begin. We may assume that based on environmental or social factors all people enter the risk at, say, age 65, but this is an explicit assumption. An example of an implicit assumption is the timing of a first birth. Until a female reaches menarche, she has no chance of becoming pregnant and having a first birth. But, after she reaches menarche, she is fecund and her risk period begins. This assumption is very important for conducting a good analysis (Yamaguchi 1991).

Censoring occurs when information about the duration of the risk period is incomplete due to a limited observation period (Yamaguchi 1991). As with the timing of a first birth, we usually cannot follow all the women until they either have a first birth or reach menopause and are no long able to have a first birth. Therefore, right censoring occurs. Subjects under observation who do not have the event occur by the time the observation is complete or leave the observation due to some other event (death) are right censored. In my analysis, women who do not have a first birth by the end of the survey period are right censored.

Hazard analysis models hazard rates. This is defined as “the ratio of the unconditional instantaneous probability of having an event divided by the survival probability” (Yamaguchi 1991; 9). In other words, it is the analysis of duration data or the nonoccurrence of an event.

There are several different hazard methods that one may choose from. I will use the Cox Proportional Hazard method. The most significant advantage of this method is that time does not need to be specified. According to Allison (1994), Cox analysis is “unequivocally the best all-around method for estimating regression models with continuous-time data” (35). The proportional hazards model assumes that the hazard rates are a log-linear function of the parameters for the effects of the co-variates. The Cox model is:

$$\log h(t) = a(t) + b_1 X_1 + b_2 X_2$$

Where *t* can be any function of time. In Cox models, time does not need to be specified (Allison 1994).

This method allows me to estimate the effects of menarche on the transition to a first birth without specifying how time works in the equation. Each woman will enter the risk period at menarche and continue until her first birth or the end of the survey. Therefore, using Cox proportional Hazard analysis, I am able to examine the duration and occurrence/non-occurrence of the event of a first birth.

Negative Binominal and Poisson Regression

In Chapter VII, I will be using Negative Binominal Regression and Poisson Regression to estimate models of children ever born. These methods are used when the dependent variable is a count variable, that is, a non-negative, integer, such as the number of children ever born. Linear regression models often do not work well for count variables unless the distribution is independently and identically distributed. Otherwise OLS models can lead to “inefficient, inconsistent, and biased estimates” (Long and Freese 2001).

Negative Binomial regression is preferred over Poisson regression when there is overdispersion of the dependent variable. If there is not a sufficient amount of overdispersion (as determined by the magnitude of the alpha coefficient), the model is reduced to the Poisson model.

The Poisson regression model is preferred when the mean and variance of the count is equal or near equal. The PRM incorporates observed heterogeneity according to the following structural equation:

$$\mu_i = \exp\left(a + X_{1i}\, b_1 + X_{2i}\, b_2 + \ldots + X_{ki}\, b_k\right)$$

where:

μ_i is the expected number of children ever born for the i^{th} woman; X_{1i}, X_{2i} ... X_{ki} are her characteristics; and a, b_1, b_2 ... b_k are the Poisson regression coefficients.

I will also examine the distribution of my CEB data. If there is an over-representation of women who have zero children (see Figures 6-10 in Appendix II), I will adjust the Poisson regression model and Negative Binominal regression model with Zero-inflated models.

Therefore, since my third dependent variable is Children Ever Born (CEB), Negative Binominal and/or Poisson are the most appropriate estimation stragegies.

Next, I will describe my dependent and independent variables and discuss the opperationalization and distributions.

DEPENDENT AND INDEPENDENT VARIABLES

Each of my chapters use slightly different independent variables, so I will first discuss the dependent and independent variables for Chapter V and then discuss the dependent and independent variables for Chapter VI and Chapter VII.

Chapter V Variables

In Chapter V, I examine age at first birth and menarche. The woman's age at giving birth to her first child is the dependent variable. Since not all of the women have given birth, I limit the sample to only those women who have had a birth. One consideration that needs mentioning is that limiting my data to only those women who have had a first birth may result in sample bias. Sample bias results when excluding some observations from the analysis because they do not meet the criteria. In my sample, some of the women have not had a first birth yet. Omitting them may bias my results because some of these may have a first birth in the future and change the outcome of my regression coefficients. While this is a concern, the number of subjects in each of my samples appears to be sufficient to counter this problem. Also, there is "no automatic way to diagnose and correct sample selection bias" (Stolzenberg and Relles 1997). My sample size for the Chinese Han includes 10,488 women; my Chinese minority sample includes 866 women; my U.S. White includes 3,617 women; the U.S. Black sample includes 1,425 women, and the U.S. Mexican-Origin sample includes 596 women.

Table 1 presents the descriptive statistics for the Chinese Han women, Table 2 is for the Chinese minorities, Table 3 is for the U.S. White Women, Table 4 is for the U.S. Black women, and Table 5 is for the U.S. Mexican-Origin women.

The mean age at first birth for the Chinese Han is 278.63 months (23.22 years) with a minimum of 143 months (11.92 years) and a maximum of 487 months (40.58 years). The mean for the Chinese Minority is 269.39 months (22.45 years) with a minimum of 161 months (13.42) and a maximum of 405 months (33.75 years). The mean age at first birth for the U.S. Whites is 285.80 months (23.82 years) with a minimum of 161 months (15.92 years) and a maximum of 494 months (41.17 years). The mean for the U.S. Blacks is 251.81 months (20.98 years) with a minimum of 152 months (12.67 years) and a maximum of 503 months (41.92 years). The U.S. Mexican-Origin women’s mean age at first birth is 257.04 months (21.42 years) with a minimum of 169 months (14.08 years) and a maximum of 439 months (36.85 years).

My main independent variable is age at menarche (menarche). In the Chinese data, it has a minimum of 120 months (10 years) and a maximum of 240 months (20) for both groups. In the U.S. data, it has a minimum of 108 months (9 years) for all three groups and a maximum of 228 months (19 years) for the Whites and Blacks and a maximum of 216 months (18 years) for the women of Mexican-Origin. The mean for the Chinese Han is 185.28 months (15.44 years), the Chinese minorities 185.75 months (15.48 years), the U.S. Whites 152.09 months (12.67 years), the U.S. Blacks 152.44 months (12.70 years), and the U.S. Mexican-Origin women 149.24 months (12.24 years).

Table 1: Descriptive Statistics of Chinese Han Women for Age at First Birth, 1997

Variable	Mean	Std. Dev.	Minimum	Maximum
Age At Birth of First Child	278.63 (23.22)	33.22	143 (11.92)	487 (40.58)
Menarche	185.29 (15.44)	21.71	120 (10)	240 (20)
Education	6.64	4.44	0	18
Rural	0.77	0.42	0	1
Policy	0.75	0.44	0	1
Fecund	191.52 (15.96)	82.65	2 (0.17)	468 (39)
Age at First Marriage	258.86 (21.57)	32.27	132 (11)	472 (39.33)
Born Before 1961	0.43	0.50	0	1
Born Between 1961 and 1970	0.44	0.50	0	1
Born After 1970	0.13	0.34	0	1

N=10,448

Source: State Family Planning Commission of China, 1997

Table 2: Descriptive Statistics of Chinese Minority Women for Age at First Birth, 1997

Variable	Mean	Std. Dev.	Minimum	Maximum
Age At Birth of First Child	269.39 (22.45)	36.73	161 (13.42)	405 (33.75)
Menarche	185.74 (15.48)	21.54	132 (11)	240 (20)
Education	4.70	4.25	0	18
Rural	0.89	0.432	0	1
Policy	0.78	0.41	0	1
Fecund	187.57 (15.63)	82.65	6 (0.50)	433 (36.08)
Age at First Marriage	247.37 (20.61)	36.37	139 (11.58)	389 (32.42)
Born Before 1961	0.33	0.47	0	1
Born Between 1961 and 1970	0.49	0.50	0	1
Born After 1970	0.19	0.39	0	1

N=886
Source: State Family Planning Commission of China, 1997

Table 3: Descriptive Statistics of U.S. Non-Hispanic White Women for Age at First Birth, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Age At Birth of First Child	285.80 (23.82)	58.19	161 (15.92)	494 (41.17)
Menarche	152.09 (12.67)	18.65	108 (9)	228 (19)
Education	13.12	2.46	0	19
Rural	0.20	0.40	0	1
Poverty	0.09	0.29	0	1
Fecund	222.81 (18.57)	79.32	33 (2.75)	412 (34.33)
Father’s Education	11.82	3.40	0	19
Mother’s Education	11.82	2.62	0	19
Mother Worked	0.54	0.50	0	1
Mother’s Age at Her First Birth	259.28 (21.61)	50.25	120 (10)	648 (54)
No/Other Religion	0.14	0.34	0	1
Protestant	0.57	0.50	0	1
Catholic	0.28	0.45	0	1
Jewish	0.02	0.13	0	1
Northwest	0.20	0.40	0	1
Midwest	0.29	0.45	0	1
West	0.20	0.40	0	1
South	0.31	0.46	0	1
Ever Married	0.94	0.24	0	1
Born Before 1961	0.55	0.48	0	1
Born Between 1961 and 1970	0.37	0.48	0	1
Born After 1970	0.08	0.27	0	1

N=3,617

Source: National Center for Health Statistics, 1995

Table 4: Descriptive Statistics of U.S. Non-Hispanic Black Women for Age at First Birth, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Age At Birth of First Child	251.81 (20.98)	54.95	152 (12.67)	503 (41.92)
Menarche	152.44 (12.70)	21.52	108 (9)	228 (19)
Education	12.42	2.15	4	19
Rural	0.07	0.25	0	1
Poverty	0.33	0.47	0	1
Fecund	189.98 (15.83)	81.06	21 (1.75)	405 (33.75)
Father’s Education	10.17	3.76	0	19
Mother’s Education	10.81	3.19	0	19
Mother Worked	0.75	0.43	0	1
Mother’s Age at Her First Birth	231.54 (19.29)	49.18	108 (9)	504 (42)
No/Other Religion	0.10	0.30	0	1
Protestant	0.84	0.37	0	1
Catholic	0.07	0.25	0	1
Northwest	0.10	0.30	0	1
Midwest	0.23	0.42	0	1
West	0.09	0.29	0	1
South	0.51	0.50	0	1
Ever Married	0.59	0.49	0	1
Born Before 1961	0.43	0.50	0	1
Born Between 1961 and 1970	0.43	0.50	0	1
Born After 1970	0.14	0.35	0	1

N=1,425
Source: National Center for Health Statistics, 1995

Table 5: Descriptive Statistics of U.S. Mexican-Origin Women for Age at First Birth, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Age At Birth of First Child	257.04 (21.42)	48.30	169 (14.08)	439 (36.58)
Menarche	149.24 (12.44)	19.77	108 (9)	216 (18)
Foreign Born	0.47	0.50	0	1
Education	10.38	3.43	0	19
Rural	0.06	0.24	0	1
Poverty	0.32	0.47	0	1
Fecund	193.85 (16.15)	72.84	30 (2.5)	392 (32.67)
Father’s Education	7.03	5.09	0	19
Mother’s Education	6.47	4.68	0	19
Mother Worked	0.44	0.50	0	1
Mother’s Age at Her First Birth	234.36 (19.53)	49.82	144 (12)	624 (52)
No/Other Religion	0.07	0.25	0	1
Protestant	0.18	0.39	0	1
Catholic	0.75	0.43	0	1
Midwest	0.07	0.25	0	1
West	0.62	0.49	0	1
South	0.31	0.46	0	1
Ever Married	0.85	0.36	0	1
Born Before 1961	0.37	0.48	0	1
Born Between 1961 and 1970	0.46	0.50	0	1
Born After 1970	0.17	0.37	0	1

N=596
Source: National Center for Health Statistics, 1995

The other independent variables are included to control for relevant social factors. I have 8 covariates for the Chinese women, 20 for the U.S. White and Black women, and 21 for the U.S. Mexican-Origin women. Three of the variables are included in all the models, while the others are country specific.

“Education” is the number of years of completed education the woman has to the date of the survey. This has a range of 0 to 18 for the Chinese women and a range of 0 to 19 for the U.S women. The Han women have a mean of 6.64 years of education; the mean for the Chinese minority women is 4.70 years; the mean for the U.S. White women is 13.12 years; the mean for the U.S. Black women is 12.42; and the mean for the U.S. Mexican-Origin women is 10.38 years.

“Rural” controls for whether a women lives in a rural or urban area (rural=1). Seventy-seven percent of the Chinese Han are rural residents, while eighty-nine percent of the Chinese minority women are rural residents. In the U.S., twenty percent of the White women, seven percent of the Black women and six percent of the Mexican-Origin women are rural residents.

Since the sample of Chinese and U.S. women is mainly comprised of women who have not yet completed childbearing, I need also to control for each woman’s exposure to the risk of childbearing. I thus include the following variable: “Fecund,” which is calculated in months for each woman, is the difference between her age at menarche and either, her age at sterilization, her age at menopause, or her age when the survey was conducted, i.e., 1995(U.S.) or 1997(China), whichever is less, minus 8 months for each live birth. Among my sample of Chinese Han women, this covariate has a mean of 191.52 months (15.96 years) with a minimum of 2 months and a maximum of 468 months (39 years). Among my sample of Chinese minority women, fecund has a mean of 187.57 months (15.63 years) with a minimum of 6 months and a maximum of 433 months (36.08 years). Among my sample of U.S. White women, fecund has a mean of 222.81 months (18.57 years) with a minimum of 33 months (2.75 years) and a maximum of 412 months (34.33 years). “Fecund” has a mean of 189.98 months (15.83 years) with a minimum of 21 (1.75 years) and a maximum of 405 months (33.75 years) in my sample of U.S. Black women. My sample of U.S. Mexican-Origin women has a mean of 193.85 months (16.15 years) with a minimum of 30 months (2.50 years) and a maximum of 392 months (32.67 years).

The remaining independent variables are country specific because the U.S. data are more extensive than the Chinese data and the cultures and policies differ. I include two additional variables in the models for the Chinese women (“policy” and “Age at First Marriage”) and fourteen additional variables for the U.S. White and Black women and fifteen for the U.S. Mexican-Origin women.

In the Chinese models, another consideration for which I must attempt to control is the effect on a woman’s childbearing of China’s one-child population policy. The one-child policy was first implemented in late 1979, and has been a major factor in determining how many children Chinese women are able to have (Poston and Yu 1986; Wolf 1986). I assume that, other things equal, women whose fertility began after the policy was first initiated will be more conscious of the timing of their births. I thus include a control variable, “policy,” which is a dummy variable indicating whether the woman’s first birth occurred after 1980; it is scored 1, if yes. The policy covariate is an imperfect measure of the effect of the policy on a woman’s fertility, but it is the best I can do with the available SSPRH data. Seventy-five percent of the Han women in my sample had their first birth after 1980

(Table 1) and seventy-eight percent of the minority women also did (Table 2).

The second additional covariate I use is to assist “Fecund” in controlling for the woman’s exposure to childbearing. “Age at first marriage” is measured in months and I can include this variable in the Chinese models because the samples are restricted to ever married women. This covariate has a mean of 258.86 months (21.57 years) with minimum of 132 months (11 years) and a maximum of 472 months (39.33 years) for the Han women, and a mean of 247.37 (20.61 years) with a minimum of 139 months (11.58 years) and a maximum of 389 months (32.42 years).

The fourteen covariates for the U.S. women include economic, parental, religious, and regional influences and the additional one variable for the Mexican-Origin women controls for immigration.

Economic status is included to control for whether a woman and her family are above or below the poverty threshold taking into account family size (below=1). The U.S. government establishes the poverty threshold based on the amount of income necessary to cover basic necessities (food, shelter, etc). Nine percent of White women, thirty-three percent of Black women, and thirty-two percent of Mexican-Origin women are below the poverty threshold.

Parents' status can influence the timing of a first birth. Therefore, I have included four variables that control for the impact of parental status.

The woman's father's education and mother's education range from 0 to 19 years. Among my sample of White women, their father's and mother's both have a mean of 11.82 years of education. Among my sample of Black women, their fathers have a mean of 10.17 years and their mothers have a mean of 10.81 years of education. Among my sample of Mexican-Origin women, their fathers have a mean of 7.03 years and their mothers have a mean of 6.47 years of education.

A working mother is thought to have both detrimental and beneficial effects on the daughter. Therefore, I include the variable "Mother Worked". This is a dummy variable coded yes if the woman's mother worked between the time the respondent was aged five to fifteen. Fifty-four percent of the White, seventy-five percent of the Black, and forty-four percent of the Mexican-Origin women's mother worked.

Often behavior is a mimic of one's parent and the age that a woman's mother was when she had her first child could influence when the daughter has her first child. Therefore, I include the variable “Mother’s Age at Her First Birth”. White women’s mothers have a mean of 259.28 months (21.61 years) with a minimum of 120 months (10 years) and a maximum of 648 months (54 years). For the Black women, their mothers have a mean age of 213.54 months (19.29 years) with a minimum of 108 months (9 years) and a maximum of 504 months (42 years). The Mexican-Origin women’s mothers have a mean of 234.36 months (19.53 years) with a minimum of 144 months (12 years) and a maximum of 624 months (52 years).

Religion may play an important roll in personal decisions such as the appropriate age to have one’s first child. Therefore, I include four dummy variables to control for religious influence: Protestant, Catholic, Jewish, and No/Other Religion. Of the White women, fifty-seven percent are Protestant, twenty-eight percent Catholic, two percent Jewish, and fourteen percent are either no religion or some other religion. Of the Black women, eighty-four percent are Protestant, seven percent Catholic, and ten percent are No/Other religion. Jewish has been dropped because only 3 Black women reported being Jewish. Of the Mexican-Origin women, eighteen percent are Protestant, seventy-five percent Catholic, and seven percent No/Other religion. Again, Jewish is dropped because only 2 Mexican-Origin women reported being Jewish.

Regional variations could influence the timing of a first birth, so I have included four dummy variables, Northwest, Midwest, West, and South. Of the White women, twenty percent live in the Northwest, twenty-nine percent in the Midwest, twenty percent in the West, and thirty-one percent in the South. Of the Black women, ten percent live in the Northwest, twenty-three percent in the Midwest, nine percent in the West and fifty-one percent in the South. Of the Mexican-Origin women, only five women live in the Northwest, so they were dropped from the sample, seven percent live in the Midwest, sixty-two percent live in the West, and thirty-one percent live in the South.

Childbearing is not limited to marriage in the U.S. as it is in some other countries, but the age when a woman has her first child may be influenced by whether or not she is married. So, I add the covariate of “Ever Married” (coded yes=1). Ninety-four percent of the White women, fifty-nine percent of the Black women, and eighty-five percent of the Mexican-Origin women have been married.

An additional concern for the Mexican-Origin women is their place of birth. Hispanics of Mexican-Origin are the largest immigration group to come to the U.S. and fertility patterns could vary based on whether the woman has assimilated to the fertility patterns in the U.S. or if she was born outside the country (Warren 1992: 106). Therefore, I include the dummy variable “Foreign Born” in the Mexican-Origin models. If the woman was born anywhere outside the U.S., she is given a 1. Forty-seven percent of the Mexican-Origin women were foreign born.

After controlling for the relevant social factors, I need to consider the eras in which the women were socialized. Culture is not stagnant and affects individual’s behaviors. Therefore, because my samples include women of varying ages, I need to include controls for societal changes. I stratify each data set into three cohorts of women, those born before 1961, those born from 1961 to 1970, and those born after 1970. Dramatic changes occurred in both China and the U.S. during these eras. Women born in China before 1961 experienced the change to Socialism after 1949, while women in the U.S. born during this time are “baby boomers”. During the 1960s in the U.S., the Sexual revolution and the Civil Rights movements influenced the women, and women growing up in China during this time were experiencing the Cultural Revolution. After 1970, women in the U.S. experienced Women's Liberation and those in China have experienced the drastic reductions in fertility. Of my sample of Chinese Han women, forty-three percent were born before 1961, forty-four percent were born from 1961 to 1970, and thirteen percent were born after 1970. Of my sample of Chinese minority women, thirty-three percent were born before 1961, forty-nine percent from 1961 to 1970, and nineteen percent after 1970. Of my sample of U.S. White women, fifty-five percent were born before 1961, thirty-seven percent between 1961 and 1970, and eight percent after 1970. Of my sample of U.S. Black women, forty-three percent were born before 1961, forty-three percent from 1961 to 1970, and fourteen percent after 1970. Of my sample of U.S. Mexican-Origin women, thirty-seven percent were born before 1961, forty-six percent between 1961 and 1970, and seventeen percent after 1970.

Chapter VI and Chapter VII Variables

Chapter VI and Chapter VII use the same independent variables. My number of cases included in these analyses is 10,879 Chinese Han women, 936 Chinese minority women, 6,102

U.S White women, 2,014 U.S. Black women, and 828 U.S. Mexican-Origin women.

Table 6 provides descriptive statistics for the Chinese Han women, Table 7 for the Chinese minority women, Table 8 for the U.S. White women, Table 9 for the U.S. Black women, and Table 10 for the U.S. Mexican-Origin women.

The dependent variable for Chapter VI consists of two components, the number of months from menarche to the first birth or the survey which ever is least, and whether a woman has given birth to her first child. The duration from menarche to first birth or survey for Chinese Han women has a mean of 94.92 months (7.91 years) with a minimum of 6 months and a maximum of 434 months (36.17 years) with 95 percent giving birth. The Chinese minority women’s duration has a mean of 85.48 months (6.87 years) with a minimum of 6 months and a maximum of 385 months (32.08 years) with 93.5 percent giving birth. The U.S. White women’s duration has a mean of 142.91 months (11.91 years) with a minimum of 0 and a maximum of 420 months (35 years). The U.S. Black women’s duration has a mean of 114.83 months (9.57 years) with a minimum of 0 and a maximum of 408 month (34 years). The duration for the U.S. Mexican-Origin women has a mean of

113.03 months (9.42 years) with a minimum of 0 and a maximum of 384 months (32 years).

Table 6: Descriptive Statistics of Chinese Han Women for the Hazard of a First Birth and CEB, 1997

Variable	Mean	Std. Dev.	Minimum	Maximum
Menarche to First Birth	94.92 (7.91)	42.32	6 (0.50)	434 (36.17)
Ever Given Birth	0.95	0.22	0	1
Children Ever Born	1.81	1.068	0	9
Menarche	184.89 (15.41)	21.76	120 (10)	240 (20)
Education	6.73	4.46	0	18
Rural	0.76	0.43	0	1
Policy	0.76	0.46	0	1
Fecund	189.20 (15.77)	82.97	2 (0.17)	468 (39)
Age at First Marriage	259.67 (21.64)	32.56	132 (11)	490 (40.83)
Born Before 1961	0.42	0.49	0	1
Born Between 1961 and 1970	0.43	0.50	0	1
Born After 1970	0.15	0.36	0	1

N=10,879

Source: State Family Planning Commission of China, 1997

Table 7: Descriptive Statistics of Chinese Minority Women for the Hazard of a First Birth and CEB, 1997

Variable	Mean	Std. Dev.	Minimum	Maximum
Menarche to First Birth	85.48 (7.12)	45.08	6 (0.50)	385 (32.08)
Ever Given Birth	0.94	0.25	0	1
Children Ever Born	2.24	1.51	0	13
Menarche	185.55 (15.46)	21.56	132 (11)	240 (20)
Education	4.73	4.29	0	18
Rural	0.89	0.32	0	1
Policy	0.74	0.44	0	1
Fecund	183.60 (15.30)	86.94	6 (0.50)	433 (36.08)
Age at First Marriage	247.61 (20.63)	36.60	139 (11.58)	389 (32.42)
Born Before 1961	0.31	0.46	0	1
Born Between 1961 and 1970	0.47	0.50	0	1
Born After 1970	0.22	0.41	0	1

N=936

Source: State Family Planning Commission of China, 1997

Table 8: Descriptive Statistics of U.S. Non-Hispanic White Women for the Hazard of a First Birth and CEB, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Menarche to First Birth	142.91 (11.91)	78.91	0	420 (35)
Ever Given Birth	0.59	0.49	0	1
Children Ever Born	1.24	1.28	0	8
Menarche	152.02 (12.67)	18.30	108 (9)	228 (19)
Education	13.19	2.59	0	19
Rural	0.17	0.38	0	1
Poverty	0.09	0.29	0	1
Fecund	199.52 (16.63)	91.05	20 (1.67)	434 (36.17)
Father’s Education	12.46	3.42	0	19
Mother’s Education	12.30	2.73	0	19
Mother Worked	0.58	0.49	0	1
Mother’s Age at Her First Birth	265.61 (22.13)	52.38	120 (10)	648 (54)
No/Other Religion	0.16	0.37	0	1
Protestant	0.54	0.50	0	1
Catholic	0.28	0.45	0	1
Jewish	0.02	0.13	0	1
Northwest	0.20	0.40	0	1
Midwest	0.29	0.46	0	1
West	0.20	0.40	0	1
South	0.31	0.46	0	1
Ever Married	0.69	0.46	0	1
Born Before 1961	0.40	0.49	0	1
Born Between 1961 and 1970	0.34	0.47	0	1
Born After 1970	0.26	0.44	0	1

N=6,102
Source: National Center for Health Statistics, 1995

Table 9: Descriptive Statistics of U.S. Non-Hispanic Black Women for the Hazard of a First Birth and CEB, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Menarche to First Birth	114.83 (9.57)	75.87	0	408 (34)
Ever Given Birth	0.71	0.46	0	1
Children Ever Born	1.58	1.46	0	8
Menarche	150.97 (12.58)	21.06	108 (9)	228 (19)
Education	12.49	2.37	0	19
Rural	0.07	0.25	0	1
Poverty	0.29	0.45	0	1
Fecund	181.62 (15.14)	86.15	14 (1.17)	424 (35.33)
Father's Education	10.71	3.75	0	19
Mother's Education	11.25	3.24	0	19
Mother Worked	0.78	0.42	0	1
Mother's Age at Her First Birth	236.61 (19.72)	50.36	108 (9)	504 (42)
No/Other Religion	0.11	0.32	0	1
Protestant	0.82	0.39	0	1
Catholic	0.07	0.26	0	1
Northwest	0.18	0.38	0	1
Midwest	0.22	0.41	0	1
West	0.09	0.30	0	1
South	0.51	0.50	0	1
Ever Married	0.48	0.50	0	1
Born Before 1961	0.35	0.48	0	1
Born Between 1961 and 1970	0.39	0.49	0	1
Born After 1970	0.26	0.44	0	1

N=2,014
Source: National Center for Health Statistics, 1995

Table 10: Descriptive Statistics of U.S. Mexican-Origin Women for the Hazard of a First Birth and CEB, 1995

Variable	Mean	Std. Dev.	Minimum	Maximum
Menarche to First Birth	113.03 (9.42)	63.45	0	384 (32)
Ever Given Birth	0.72	0.45	0	1
Children Ever Born	1.85	1.67	0	11
Menarche	148.88 (12.41)	19.60	108 (9)	216 (18)
Foreign Born	0.40	0.50	0	1
Education	10.77	3.26	0	19
Rural	0.06	0.24	0	1
Poverty	0.29	0.46	0	1
Fecund	177.69 (14.81)	80.54	15 (1.25)	395 (32.92)
Father’s Education	7.79	5.11	0	19
Mother’s Education	7.34	4.74	0	19
Mother Worked	0.51	0.40	0	1
Mother’s Age at Her First Birth	240.51 (20.04)	52.20	144 (12)	624 (52)
No/Other Religion	0.08	0.28	0	1
Protestant	0.19	0.39	0	1
Catholic	0.73	0.44	0	1
Midwest	0.08	0.27	0	1
West	0.61	0.49	0	1
South	0.31	0.46	0	1
Ever Married	0.68	0.47	0	1
Born Before 1961	0.29	0.46	0	1
Born Between 1961 and 1970	0.39	0.49	0	1
Born After 1970	0.31	0.46	0	1

N=828

Source: National Center for Health Statistics, 1995

I graphically illustrate the number of women who do not survive having a birth from one month to the next (See Appendix I). Figure 1 is the Kaplan-Meier Survival estimates for the Chinese Han women. This estimates the number of Chinese Han women who succumb to the hazard of the first birth for each month. For instance, at 100 months (8.33 years), approximately fifty-five percent of the Han women have given birth to their first children. Figure 2 is the Kaplan-Meier Survival estimates for the Chinese minority women. At 100 months, approximately sixty percent have succumbed to the hazard of a first birth. Figure 3 is the Kaplan-Meier Survival estimates for U.S. White women. At 100 months, approximately twenty-five percent have succumbed to the hazard of a first birth. Figure 4 is the Kaplan-Meier Survival estimates for U.S. Black women. At 100 months, approximately forty-three percent have succumbed to the hazard of a first birth. Figure 5 is the Kaplan-Meier Survival estimate for U.S. Mexican-Origin women. At 100 months, approximately forty-eight percent have succumbed to the hazard of a first birth.

As noted, my dependent variable in Chapter VII is the number of Children Ever Born (CEB). In the sample of Chinese Han women it has a mean of 1.8, with a range from zero to nine. CEB for the Chinese minority women has a mean of 2.2 and a range of 0 to 13. The U.S. White women's mean CEB is 1.2 and the U.S. Black women's mean CEB is 1.6. Both have a range of 0 to 8. The U.S. Mexican-Origin women's mean CEB is 1.9 with a range of 0 to 11.

I have plotted the observed CEB distributions (represented by circles) for the five groups (See Appendix 2). The Chinese Han (Figure 6) and Chinese minority (Figure 7) women have fewer zeros than ones, but the one child response is greater than any other number of CEB. But, for all groups of U.S. women, more have no children than those having one or more (Figure 8, Figure 9, and Figure 10).

I have also plotted the Univariate Poisson distributions (represented by triangles) for these five distributions. Comparing the observed distribution and the Univariate Poisson distribution with a mean of 1.8 for the Chinese Han women (Figure 6), Poisson over estimates the numbers of zeros, ones, and twos, is close at three, four and five, and is accurate from six on. For the Chinese minority women (Figure 7), the Univarite Poisson distribution, with a mean of 2.2, over predicts the number of zeros, under predicts one and two, is very close at three, but over predicts four and five, and is accurate from six on. The Univariate Poisson distribution with a mean of 1.2 for the White women (Figure 8) under predicts the number of zeros, over predicts the number of ones, slightly under predicts the number of twos and threes, but is accurate from four on. The mean for the Univariate Poisson distribution for the Black women is 1.6. Zeros are under predicted, ones are over predicted, but the distribution is accurate for the remainder (Figure 9). The Univariate Poisson distribution with a mean of 1.9 for the Mexican-Origin women under predicts zeros, over predicts ones and twos, slightly under predicts threes and fours, but is accurate from five on.

My major independent variable, the woman’s age at menarche, for the Han women, has a mean of 184.89 months (15.41 years) and ranges from a low of 120 months (10 years) to a high of 240 months (20 years). Age at menarche for the Chinese minority women has a mean of 185.55 months (15.46 years) and ranges from a low of 132 months (11 years) to a high of 240 months. U.S. White women’s age at menarche has a mean of 152.02 months (12.67 years), and the U.S. Black women have a mean of 150.97 months (12.58 years); both groups’ age at menarche ranges from 108 months (9 years) to 228 months (19 years). The U.S. Mexican-Origin women’s mean age at menarche is 148.88 months (12.41 years) with a range from 108 months (9 years) to 216 months (18 years). The other variables used here are similar in distribution to those used in previous chapters.

The next chapter will report the results of my Ordinary Least Squares models for age at first birth and menarche.

CHAPTER V

AGE AT FIRST BIRTH

In this chapter, I will discuss the results of my Ordinary Least Squares regression models. I predict that as a woman’s age at menarche increases her, age at first birth will increase, controlling for numerous social influences. I include six models for the two Chinese groups, eight models each for the U.S. non-Hispanic White and Black women, and nine models for the U.S. Mexican-Origin women. I will first discuss the models for the Chinese Han women, then those for the Chinese minority, next, the models for the U.S. Whites, Blacks, and Mexican-Origins women. Finally, I will conclude with a discussion about how the models for all of the groups are similar and different.

CHINESE HAN

Table 11 presents the results of the six OLS regression models for the Chinese Han women. I include 10,484 ever married women who have experienced the birth of a first child.

Model 1 includes only the biological variable of interest, the woman’s age at menarche. The coefficient is

Table 11: Ordinary Least Squares Regression for Age at First Birth and Menarche for Chinese Han Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Beta
Menarche	-0.020 (0.015)	0.145*** (0.015)	0.178*** (0.015)	0.293*** (0.014))	0.053*** (0.006)	0.041*** (0.006)	0.027
Education	___	1.547*** (0.080)	1.168*** (0.083)	1.020*** (0.076))	0.053*** (0.006)	0.010 (0.031)	0.001
Rural	___	-19.149*** (0.820)	-0.879*** (0.818)	-11.407*** (0.772)	-0.063 (0.319)	0.002 (0.318)	0.000
Policy	___	___	11.259*** (0.735)	24.381*** (0.726)	2.421*** (0.312)	4.626*** (0.377)	0.061
Fecund	___	___	___	0.176*** (0.004)	0.031*** (0.002)	0.023*** (0.002)	0.058
Marriage Age	___	___	___	___	0.935*** (0.004)	0.926*** (0.004)	0.899
Born Before 1961	___	___	___	___	___	REFERENCE	
Born Between 1961 and 1970	___	___	___	___	___	-3.532*** (0.351)	-0.053
Born After 1970	___	___	___	___	___	-4.357*** (0.489)	-0.044
Constant	282.362	256.202	245.520	174.332	19.369	25.621	
Adjusted R^2	0.0001	0.1401	0.1589	0.3033	0.8839	0.8851	

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

not significant and its sign is negative. If significant, this would mean that a one month increase in a woman's age at menarche will lead to a 0.20 month (six days) decrease in her age at first birth.

Moving to Model 2, I include two social variables, education and rural residency. All three variables are significant at 0.001. And, age at menarche reverses it sign to positive, which is as hypothesized. After controlling for the woman's years of education and whether she is a rural resident, a Han woman's age at her first birth will increase 0.145 months (4.35 days) for every one month increase in her age at menarche. These three variables explain more of the variance than menarche alone. Fourteen percent of the variance in the women's ages at their first births is explained by menarche, education, and rural residency.

In Model 3, I add a control for China's One Child Policy. All the coefficients are significant at 0.001. And a bit more of the variance is explained. Adding Policy increase the Adjusted R^2 to 0.1589, meaning that almost 16 percent of the variance is now explained. Menarche also increases in value. After controlling for education, rural, and policy, every month increase in Han woman’s age at menarche will lead to a 0.18 months (5.28 days) increase in her age at her first birth.

Model 4 adds the amount of time the woman has been fecund. This doubles the amount of variance explained to 30.33 percent and all of the variables remain significant. Menarche again increases in value so that with every month increase in a Han woman’s age at menarche, she will increase her age at giving birth to her first child by 0.293 months (8.79 days) while holding the other variables constant.

In Model 5, I add the woman’s age at her first marriage. As can be seen the Adjusted R^2 increases to show that 88.39 percent of the variance in a woman’s age at her first birth is now accounted for. While the value of menarche decreases, it is still positive and significant. Every month increase in a Han woman’s age at menarche will increase her age at first birth by 0.053 months (1.59 days) after controlling for her years of education, rural residency, the One Child Policy, months fecund, and her age at her first marriage.

Model 6 is the final model and it includes all of the previous independent variables along with controls for the three cohorts. Those women born before 1961 are the reference group. Adding the cohorts only slightly increases the explanatory power of the model. The Adjusted R^2 shows that the complete model explains 88.51 percent of the variance in a woman's age at first birth. Menarche is still significant at 0.001 and shows that after holding all the other variables constant, for every one month increase in Han woman's age at menarche, she will experience a 0.041 month (1.23 days) increase in her age at first birth.

The final column of Table 1 presents the partial slopes or beta coefficients. Beta coefficients allow the comparison of the magnitude of the partial slopes of each variable on the dependent variable by standardizing the slope so that each coefficient is using the same metric. Therefore, I can see how much influence each variable has on a woman's age at first birth. As expected, her age at marriage has the largest influence, but my main concern is her age at menarche. The effect of age at menarche is 0.027, meaning that a one standard deviation in menarche will result in a 0.027 standard deviation increase in age at first birth. Compared to the results of Model 6, I may conclude that fecund and policy have quite an effect on age at first birth. But menarche retains its influence

CHINESE MINORITIES

Moving on to Table 12, I will discuss the OLS results of the six models for the Chinese minority women. These models are also restricted to ever married women who have had a first birth. My sample includes 886 women.

Model 1 includes the biological variable of interest, the woman's age at menarche. The coefficient is significant at 0.01 and its sign is positive. A one month increase in a Chinese minority woman's age at menarche will increase in her age at first birth 0.16 months (4.8 days).

Adding social variables in Model 2 increases the significance and influence of age at menarche. All three variables are significant. After controlling for the woman's years of education and whether she is a rural resident, a Chinese minority woman's age at her first birth will increase 0.248 months (7.44 days) for every one month increase in her age at menarche.

In Model 3, I control for China's One Child Policy. All the coefficients are significant. Menarche again increases in value over the previous model.

In Model 4 I control for fecundity. Menarche again increases in value so that for every month increase in a Chinese minority woman's age at menarche, she will increase

Table 12: Ordinary Least Squares Regression for Age at First Birth and Menarche for Chinese Minority Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Beta
Menarche	0.160** (0.057)	0.160** (0.057)	0.251*** (0.058)	0.301*** (0.053)	0.093*** (0.025)	0.077** (0.026)	0.045
Education	___	0.248*** (0.058)	1.223*** (0.324)	0.883* (0.299)	-0.050 (0.139)	-0.044 (0.139)	-0.005
Rural	___	1.404*** (0.321)	-9.616* (4.191)	-3.645 (3.877)	2.155 (1.793)	2.086 (1.783)	0.181
Policy	___	___	9.258** (2.959)	35.469*** (3.401)	3.114 (1.670)	7.042*** (2.034)	0.079
Fecund	___	___	___	0.210*** (0.016)	0.045*** (0.008)	0.030** (0.010)	0.069
Marriage Age	___	___	___	___	0.890*** (0.016)	0.881*** (0.016	0.873
Born Before 1961	___	___	___	___	___	REFERENCE	
Born Between 1961 and 1970	___	___	___	___	___	-6.421*** (1.887)	-0.087
Born After 1970	___	___	___	___	___	-7.595** (2.487	-0.081
Constant	239.621	224.314	218.296	137.981	19.360	29.032	
Adjusted R^2	0.0077	0.0450	0.0545	0.2023	0.8300	0.8319	

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

her age at giving birth to her first child by 0.301 months (9.03 days) while holding the other variables constant.

In Model 5, I control the woman's age at her first marriage. The value of menarche decreases, but it is still positive and significant. Every month increase in a Chinese minority woman's age at menarche will increase her age at first birth by 0.093 months (2.79 days) after controlling for her years of education, rural residency, the One Child Policy, months fecund, and her age at her first marriage.

In the final model (Model 6), I control for cohort variation. Menarche is still significant at 0.001 and shows that after holding all the other variables constant, for every one month increase in Chinese minority woman's age at menarche, she will experience a 0.08 month (2.31 days) increase in her age at first birth.

The final column of Table 12 reports the beta coefficients. As expected, a woman's age at marriage has the largest influence, but my main concern is her age at menarche. The effect of age at menarche is 0.045 meaning that a one standard deviation in menarche will result in a 0.045 standard deviation increase in age at first birth.

U.S. NON-HISPANIC WHITE

I now turn to my discussion of the eight OLS regression models for the U.S. Non-Hispanic White women (Table 13). I include 3,617 single and ever married women who have had their first birth.

Model 1, menarche is significant at 0.01. Menarche alone explains 0.62 percent of the variance in White women's ages at their first births. In that for every one month increase in her age at menarche, her age at first birth will increase 0.251 months (7.53 days).

I add controls for education level, rural residency, and poverty status in Model 2. All four independent variables are significant at 0.001. Menarche does lose some of its value over the previous model but, with every one month increase in age at menarche, age at first birth will increase 0.19 months (5.82 days).

In Model 3, I control for fecund and menarche actually increases in value. A White woman's age at first birth will increase 0.44 months (13.32 days) for every month increase in age at menarche, holding the other variables constant.

In Model 4, I also control for parental influence. Father's and Mother's education, whether the mother of the

Table 13: Ordinary Least Squares Regression for Age at First Birth and Menarche for U.S. Non-Hispanic White Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4
Menarche	0.251** (0.052)	0.194*** (0.044)	0.444*** (0.041)	0.437*** (0.041)
Education	—	11.717*** (0.343)	8.911*** (0.333)	7.946** (0.365)
Rural	—	-11.126*** (2.066)	-8.625*** (1.900)	-7.234*** (1.904)
Poverty	—	-16.445*** (2.865)	-6.221* (2.660)	-5.885* (2.646)
Fecund	—	—	0.272*** (0.011)	0.267*** (0.011)
Father's Education	—	—	—	0.708** (0.258)
Mother's Education	—	—	—	0.725* (0.336)
Mother Worked	—	—	—	-0.906 (1.514)
Mother's Age at Her First Birth	—	—	—	0.072*** (0.016)
No/Other Religion	—	—	—	—
Protestant	—	—	—	—
Catholic	—	—	—	—
Jewish	—	—	—	—
Northwest	—	—	—	—
Midwest	—	—	—	—
West	—	—	—	—
South	—	—	—	—
Ever Married	—	—	—	—
Born Before 1961	—	—	—	—
Born Between 1961 and 1970	—	—	—	—
Born After 1970	—	—	—	—
Constant	247.562	106.142	43.132	22.405
Adjusted R^2	0.0062	0.2919	0.4032	0.4102

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

Table 13: Continued

Independent Variable	Model 5	Model 6	Model 7	Model 8	Beta
Menarche	0.431*** (0.041)	0.432*** (0.041)	0.432*** (0.041)	0.440*** (0.042)	0.141
Education	7.877*** (0.367)	7.907*** (0.367)	7.901*** (0.367)	7.824*** (0.366)	0.330
Rural	-6.984*** (1.926)	-6.761*** (1.940)	-6.793*** (1.942)	-6.925*** (1.932)	-0.047
Poverty	-5.362* (2.649)	-5.434* (2.646)	-5.269* (2.677)	-5.253* (2.662)	-0.026
Fecund	0.264*** (0.011)	0.263*** (0.011)	0.262*** (0.011)	0.281*** (0.013)	0.382
Father's Education	0.706** (0.258)	0.706** (0.259)	0.711** (0.259)	0.654* (0.259)	0.038
Mother's Education	0.760* (0.336)	0.783* (0.337)	0.784* (0.337)	0.678* (0.336)	0.031
Mother Worked	-0.795 (1.513)	-0.864 (1.513)	-0.840 (1.514)	-0.971 (1.507)	-0.008
Mother's Age at Her First Birth	0.068*** (0.016)	0.066*** (0.016)	0.066*** (0.016)	0.070*** (0.016)	0.061
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	REFERENCE	
Protestant	4.743* (2.264)	4.904* (2.281)	4.846* (2.286)	4.848* (2.273)	0.041
Catholic	8.014*** (2.499)	7.030** (2.530)	6.987** (2.533)	6.409* (2.521)	0.049
Jewish	10.918 (6.174)	9.472 (6.187)	9.395 (6.193)	9.868 (6.157)	0.022
Northwest	—	REFERENCE	REFERENCE	REFERENCE	
Midwest	—	-5.840** (2.192)	-5.858** (2.193)	-5.549* (2.184)	-0.043
West	—	-6.393** (2.403)	-6.423** (2.404)	-6.313** (2.391)	-0.043
South	—	-5.714** (2.229)	-5.761** (2.232)	-5.579* (2.221)	-0.044
Ever Married	—	—	1.355 (3.281)	-0.219 (3.427)	-0.001
Born Before 1961	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	10.022*** (1.802)	0.083
Born After 1970	—	—	—	-2.080 (3.583)	-0.010
Constant	20.302	25.163	24.239	18.612	
Adjusted R^2	0.4116	0.4127	0.4125	0.4190	

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

woman worked when the woman was a child, and the woman's mother's age at her first birth are included. All the variables are significant except whether the respondent's mother worked. Menarche loses just a little of its value, but a one month increase in age at menarche will increase a White woman's age at first birth by 0.44 months (13.11 days) controlling for the other variables.

Model 5 controls for religious affiliation. Reporting either no religion or a religion other than Protestant, Catholic, or Jewish is the reference group. This adds very little to the model in terms of explanatory power. But, menarche remains significant when controlling for the other variables. A one month increase in menarche will increase age at first birth 0.431 months (12.93 days).

In Model 6, I control for regional variations. Women who live in the Northwest part of the U.S. are the reference group. Again, adding these variables add a minimal amount to the explanatory power of the model. But, menarche remains significant. Controlling for the other variables, one month increase in a woman's age at menarche will increase her age at first birth 0.43 months (12.96 days).

I add a control for whether the woman has ever been married in Model 7. Menarche has no change in value or significance. In Model 8, I control for cohort status. Again, women born before 1961 are my reference group. Controlling for all the other variables, a one month increase in age at menarche will increase age at first birth by 0.44 months (13.2 days).

Again, what is the impact of age at menarche on age at first birth? The beta column shows that fecund has the largest effect, and education is next. But, age at menarche follows and has a larger effect than any of the other covariates.

U.S. NON-HISPANIC BLACK

Next, I discuss the OLS results for the U.S. Non-Hispanic Black women. Table 14 reports the results of the eight models. I include 1,425 single and ever married women in this analysis.

Model 1 again includes only menarche and is only significant at 0.05. Menarche alone explains 0.39 percent of the variance in Black women's ages at their first births. A one month increase in age at menarche will increase age at first birth 0.17 months (5.19 days).

Table 14: Ordinary Least Squares Regression for Age at First Birth and Menarche for U.S. Non-Hispanic Black Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4
Menarche	0.173* (0.068)	0.175** (0.060)	0.388*** (0.057)	0.391*** (0.057)
Education	—	10.311*** (0.629)	7.952*** (0.605)	7.811*** (0.626)
Rural	—	-3.597 (5.245)	-5.717 (4.871)	-4.521 (4.900)
Poverty	—	-16.061*** (2.883)	-9.806*** (2.708)	-9.805*** (2.708)
Fecund	—	—	0.244*** (0.016)	0.247*** (0.016)
Father's Education	—	—	—	0.725* (0.362)
Mother's Education	—	—	—	-0.218 (0.431)
Mother Worked	—	—	—	-5.937* (2.788)
Mother's Age at Her First Birth	—	—	—	0.007 (0.025)
No/Other Religion	—	—	—	—
Protestant	—	—	—	—
Catholic	—	—	—	—
Northwest	—	—	—	—
Midwest	—	—	—	—
West	—	—	—	—
South	—	—	—	—
Ever Married	—	—	—	—
Born Before 1961	—	—	—	—
Born Between 1961 and 1970	—	—	—	—
Born After 1970	—	—	—	—
Constant	225.508	102.667	51.255	49.740
Adjusted R^2	0.0039	0.2199	0.3276	0.3300

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

Table 14: Continued

Independent Variable	Model 5	Model 6	Model 7	Model 8	Beta
Menarche	0.389*** (0.057)	0.387*** (0.057)	0.387*** (0.057)	0.399*** (0.058)	0.156
Education	7.856*** (0.626)	7.775*** (0.627)	7.806*** (0.639)	7.782*** (0.637)	0.305
Rural	-4.033 (4.914)	-6.473 (5.055)	-6.426 (5.060)	-7.074 (5.043)	-0.032
Poverty	-9.553*** (2.710)	-9.512*** (2.711)	-9.638*** (2.755)	-10.098*** (2.747)	-0.086
Fecund	0.255*** (0.016)	0.245*** (0.017)	0.246*** (0.017)	0.265*** (0.020)	0.391
Father's Education	0.716* (0.363)	0.753* (0.364)	0.748* (0.364)	0.571 (0.369)	0.039
Mother's Education	-0.255 (0.431)	-0.198 (0.432)	-0.202 (0.432)	-0.321 (0.432)	-0.019
Mother Worked	-5.864* (2.792)	-5.770* (2.792)	-5.819* (2.799)	-6.047* (2.792)	-0.048
Mother's Age at Her First Birth	0.005 (0.025)	0.004 (0.025)	0.003 (0.025)	0.003 (0.025)	0.002
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	REFERENCE	
Protestant	1.517 (4.064)	1.419 (4.091)	1.379 (4.095)	1.621 (4.096)	0.011
Catholic	10.475 (6.001)	9.965 (6.006)	9.952 (6.008)	10.465 (5.992)	0.048
Northwest	—	REFERENCE	REFERENCE	REFERENCE	
Midwest	—	-5.261 (3.863)	-5.254 (3.864)	-4.425 (3.857)	-0.034
West	—	-2.088 (4.925)	-2.010 (4.935)	-0.735 (4.930)	-0.004
South	—	1.987 (3.435)	2.068 (3.450)	2.465 (3.439)	0.022
Ever Married	—	—	-0.685 (2.635)	-0.077 (2.790)	-0.001
Born Before 1961	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	10.176*** (2.965)	0.092
Born After 1970	—	—	—	4.686 (4.988)	0.030
Constant	48.665		19.827	42.106	
Adjusted R^2	0.3308	0.3321	0.3316	0.3369	

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

In Model 2 I add as controls years of education and rural residency. Menarche’s significance increases to 0.01 and its value increases slightly in that for every one month increase in age at menarche, age at first birth will increase 0.18 months (5.25 days).

In Model 3, I add fecund, and menarche increases in value and significance again. In this model, age at first birth will increase by 0.39 months (11.64 days) for every one month increase in age at menarche, holding the other variables constant

Parental influence variables add very little to the explanatory value of the model (Model 4), but menarche again increases in its value. Controlling for the other variables, one month increase in a Black woman’s age at menarche will increase her age at first birth by 0.39 months (11.73 days).

Controlling for religious affiliation in Model 5 also adds very little to the model in terms of explanatory power. But, menarche remains significant when controlling for the other variables and one additional month of age at menarche will add 0.39 months (11.67 days) to a Black woman’s age at first birth.

Regional variations are added to the model and again the explanatory power of the model increases only slightly, but menarche remains significant. Controlling for the other variables, one month increase in age at menarche will increase age at first birth 0.39 months (11.61 days).

As with the Non-Hispanic White women, it appears that for Non-Hispanic Black women in the U.S. being married has little effect on age at first birth. Adding whether the woman has ever been married to Model 7 actually decreases the Adjusted R^2 slightly. Age at menarche has no change in value or significance from Model 6.

In Model 8, I add cohorts. Again, women born before 1961 are my reference group. Controlling for all the other variables, a one month increase in age at menarche will increase age at first birth by 0.40 months (11.97 days).

Again, what is the impact of age at menarche on age at first birth? The beta column shows that the outcome is similar that of the White women. Fecund has the largest effect, and education is next. But, age at menarche follows and, again, has a larger effect than any of the other covariates.

U.S. Mexican-Origin

Next, I will discuss the OLS results for the U.S. Mexican-Origin women as presented in Table 14. This includes 596 single and ever married women of Mexican-Origin.

Menarche alone explains 1.74 percent of the variance in Mexican-Origin women's ages at their first births and is significant at $p<0.001$ (Model 1). Her age at first birth will increase 0.34 months (10.14 days) every month that her age at menarche increases.

Because of differences in fertility patterns between native and foreign-born Mexican-Origin women, I include in Model 2 whether the woman was born outside the U.S. or is native born. Menarche maintains significance and after controlling for whether the woman was foreign-born, every month increase in age at menarche will result in an increase of 0.32 months (9.45 days) increase in age at first birth.

Education level, rural residency, and poverty status are added in Model 3. All five independent variables are significant. All things being equal, a one month increase in menarche will increase age at first birth by 0.44 months (13.17 days) for Mexican-Origin women.

Table 15: Ordinary Least Squares Regression for Age at First Birth and Menarche for U.S. Mexican-Origin Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Menarche	0.338*** (0.099)	0.315** (0.103)	0.439*** (0.096)	0.623*** (0.087)	0.610*** (0.088)
Foreign Born	—	3.426 (4.066)	15.651*** (4.101)	10.252** (3.701)	10.039* (3.927)
Education	—	—	4.824*** (0.605)	4.378*** (0.543)	4.402*** (0.595)
Rural	—	—	-23.603** (7.623)	-16.588* (6.854)	-16.790* (6.879)
Poverty	—	—	-13.223*** (4.049)	-4.211 (3.703)	-4.293 (3.738)
Fecund	—	—	—	0.284*** (0.024)	0.278** (0.024)
Father’s Education	—	—	—	—	-0.338 (0.422)
Mother’s Education	—	—	—	—	0.206 (0.492)
Mother Worked	—	—	—	—	-2.175 (3.422)
Mother’s Age at Her First Birth	—	—	—	—	0.253 (0.034)
No/Other Religion	—	—	—	—	—
Protestant	—	—	—	—	—
Catholic	—	—	—	—	—
Midwest	—	—	—	—	—
West	—	—	—	—	—
South	—	—	—	—	—
Ever Married	—	—	—	—	—
Born Before 1961	—	—	—	—	—
Born Between 1961 and 1970	—	—	—	—	—
Born After 1970	—	—	—	—	—
Constant	206.670	208.387	139.855	61.256	60.179
Adjusted R^2	0.0174	0.0170	0.1604	0.3261	0.3233

Note: Numbers in parentheses are standard errors
*p<0.05 **p<0.01 ***p<0.001

Table 15: Continued

Independent Variable	Model 6	Model 7	Model 8	Model 9	Beta
Menarche	0.607*** (0.088)	0.603*** (0.089)	0.601*** (0.089)	0.587*** (0.091)	0.240
Foreign Born	10.354** (3.966)	10.459** (4.004)	10.132* (4.022)	9.756* (4.036)	0.101
Education	4.400*** (0.596)	4.405*** (0.496)	4.351*** (0.600)	4.235*** (0.603)	0.301
Rural	-17.479* (6.927)	-17.724* (6.953)	-18.164** (6.973)	-18.595** (6.960)	-0.093
Poverty	-4.960 (3.781)	-4.606 (3.826)	-4.450 (3.831)	-4.008 (3.834)	-0.039
Fecund	0.278*** (0.024)	0.277*** (0.024)	0.273*** (0.025)	0.297*** (0.034)	0.418
Father’s Education	-0.372 (0.424)	-0.401* (0.427)	-0.396 (0.427)	-0.367 (0.430)	-0.039
Mother’s Education	0.188 (0.492)	0.211 (0.493)	0.228 (0.494)	0.297 (0.494)	0.029
Mother Worked	-1.724 (3.442)	-1.783 (3.456)	-1.590 (3.464)	-1.445 (3.456)	-0.015
Mother’s Age at Her First Birth	0.025 (0.034)	0.022 (0.035)	0.022 (0.035)	0.024 (0.035)	0.025
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	REFERENCE	
Protestant	-8.605 (7.510)	-8.861 (7.596)	-9.306 (7.615)	-9.192 (7.617)	-0.066
Catholic	-8.917 (6.801)	-9.037 (6.857)	-9.276 (6.864)	-8.278 (6.873)	-0.074
Midwest	—	REFERENCE	REFERENCE	REFERENCE	
West	—	-5.928 (6.623)	-5.989 (6.625)	-4.542 (6.644)	-0.046
South	—	-6.745 (6.930)	-7.140 (6.946)	-5.808* (6.966)	-0.056
Ever Married	—	—	4.174 (4.832)	2.312 (4.959)	0.017
Born Before 1961	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	6.171 (4.425)	0.064
Born After 1970	—	—	—	-2.973 (7.111)	-0.023
Constant	69.345	76.542	74.931	73.239	
Adjusted R^2	0.3230	0.3218	0.3215	0.3247	

Note: Numbers in parentheses are standard errors
$^*p<0.05$ $^{**}p<0.01$ $^{***}p<0.001$

In Model 4, I add fecund and menarche increases in value. As a woman’s age at menarche increase each month, her age at giving birth to her first child will increase 0.62 months (18.69 days), holding the other variables constant.

In Model 5 I add controls for parental influence. Menarche loses part of its influence but only few hours. Increasing age at menarche by one month will increase age at first birth by 0.61 months (18.3 days) controlling for the other variables, which is only 0.39 days (9.4 hours).

Model 6 adds religious affiliation and I again, drop Jewish because few Mexican-Origin women report being Jewish. Menarche remains significant when controlling for the other variables. A one month increase in menarche will increase age at first birth 0.607 months (18.21 days).

Northwest is dropped from Model 7, because very few women in the sample of Mexican-Origin women live in this region. So, women who live in the Midwest part of the U.S. are the reference group. Menarche remains significant. Controlling for the other variables, the age when a Mexican-Origin woman will give birth to her first child increases 0.603 months (18.09 days) every month her age at menarche increase.

The explanatory power of the model decreases slightly after adding whether the woman has ever been married. As with the White and Black women ever married is not significant in neither Model 8 nor the final model. Menarche decreases in value slightly, but only by hours (0.002 months, 1.44 hours).

In the final model age at menarche retains its significance and after controlling for all the other variables, age at first birth will increase 0.587 months (17.6 days) for each additional month of age at menarche.

Again, what is the impact of age at menarche on age at first birth? As with the White and Black women the beta column shows that fecund has the largest effect, and education is next. Again, age at menarche follows and has a larger effect than any of the other covariates.

DISCUSSION

In all the final models for all the groups, age at menarche is significant and positive in predicting age at first birth after controlling for the numerous social, political, religious, and regional variations. This is consistent with my hypothesis. Age at menarche is not the most significant variable, but it does have more influence than some of the social factors.

In all the final models for the U.S. women, only the amount of time a woman has been fecund and her years of education influence her age at first birth more than her age at menarche.

In the Chinese models, age at first marriage is the most important variable for predicting age at first birth. This is expected since childbearing is almost always within marriage, but a woman’s age at menarche is significant where years of education and rural residency are not.

While many of the social, political, religious, and regional variables have significance in all or some of the models, age at menarche is consistently significant in the full models and is one of the most important variables predicting age at first birth.

The next chapter will report the result for the Cox Proportional Hazard analysis of the duration to a first birth following menarche.

CHAPTER VI

HAZARD OF A FIRST BIRTH

In this chapter, I will discuss the results from my hazard analyses of a first birth. The dependent variable consists of two components: 1) time (age from menarche to the first birth or the survey, which ever is least); and 2) whether the event (a first birth) occurred. I am predicting that age at menarche will have a positive effect on a woman’s hazard of having a first birth. I will first discuss the results for the Chinese Han women, then the Chinese minority women, next the U.S. White women, then the U.S. Black women, and finally the U.S. Mexican-Origin women. I will end this chapter with a discussion about the similarities and differences between the five groups.

In the tables, the numbers in parentheses are the standard errors and the numbers in brackets are the hazard ratios. The hazard ratios are derived by exponentiating the hazard coefficients. This leads to a more intuitive interpretation. I will use the hazard ratios in my discussions.

CHINESE HAN

The results for the 10,879 Chinese Han women are reported in Table 16.

In Model 1, I include only the biological variable of age at menarche. Menarche is significant and positive. The interpretation is that for every month increase in age at menarche, a Han woman’s hazard of experiencing a first birth increases by 2.7 percent. The Pseudo R^2 is the degree of fit and this shows that the fit is far from perfect.

In Model 2, I add years of education and rural residency. All three variables are significant; a one month increase in menarche will increase the hazard of a first birth by 2.3 percent, holding the other two variables constant. In Model 3, I add a control for the One Child Policy; it is not significant. The other three variables remain significant.

In Model 4, I add the number of months a woman has been fecund. While this does not change the predictive value of age at menarche (the coefficient is the same as in Model 2 and Model 3), it does increase the effect of education and decreases the effect of rural.

Because childbearing is almost exclusively limited to married women, their age at first marriage is added in

Model 5. The effect of menarche now actually increases; for every additional month in age at menarche, a woman’s hazard of experiencing a first birth increases by 3.8 percent, controlling for the effects of the other variables.

Because not all women have been exposed to the same cultural influences and are vastly different ages, Model 6 includes the cohort variables. Those women born before 1961 are the reference group. Of importance in this dissertation is the finding that menarche is still significant and positive. An additional month in a Chinese Han woman’s age at menarche will increase her hazard of experiencing a first birth by almost four percent after controlling for the other variables.

Next, I will discuss the six Hazard results for the Chinese minority women.

Table 16: Cox Proportional Hazard Analysis for the Hazard of a First Birth and Menarche for Chinese Han Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Percent Change
Menarche	0.026*** (0.001) [1.027]	0.023*** (0.001) [1.023]	0.023*** (0.001) [1.023])	0.023*** (0.001) [1.023]	0.037*** (0.001) [1.038]	0.036*** (0.001) [1.036]	3.6
Education	—	-0.032*** (0.003) [0.968]	-0.032*** (0.003) [0.968]	-0.042*** (0.003) [0.959]	-0.006* (0.027) [0.994]	-0.001 (0.003) [0.999]	-0.1
Rural	—	0.500*** (0.027) [1.649]	0.501*** (0.027) [1.650]	0.257*** (0.028) [1.294]	-0.067* (0.027) [0.935]	-0.056* (0.028) [0.945]	-5.5
Policy	—	—	-0.007 (0.023) [0.993]	-0.135*** (0.023) [0.874] -	0.239*** (0.025) [1.270]	0.279*** (0.026) [1.322]	32.2
Fecund	—	—	—	-0.005*** (0.000) [0.995]	-0.003*** (0.000) [0.997]	-0.005*** (0.000) [0.995]	-0.5
Marriage Age	—	—	—	—	-0.034*** (0.000) [0.967]	-0.034*** (0.000) [0.966]	-3.4
Born Before 1961	—	—	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	—	—	-0.240*** (0.026) [0.787]	-21.3
Born After 1970	—	—	—	—	—	-0.469*** (0.040) [0.626]	-37.4
Pseudo R^2	0.0171	0.0228	0.0228	0.0288	0.0764	0.0773	
Final Log Likelihood	-84846.999	-84349.001	-84348.96	-83838.473	-79726.185	-79652.22	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios *p<0.05 **p<0.01 ***p<0.001

CHINESE MINORITY

Table 17 reports the results of the six Hazard models for the 939 Chinese minority women.

In Model 1, age at menarche is significant; for every month older a woman is at menarche, her hazard of a first birth will increase by 1.7 percent. This is the only variable included in this model. Model 2 adds years of education and rural residency, and the menarche variable remains significant. In Model 3, I add the policy control, and this does not change the effect of menarche on the hazard of a first birth. In Model 4, I add the number of months the woman has been fecund. Again, this does not change the value or significance of menarche. In Model 5 I add the woman's age at first marriage. The effect of menarche increases in that for every month increase in menarche, the hazard increases to 2.5 percent.

Model 6 is the full model and controls for cohort differences. The variable of interest, menarche, maintains its significance; for every month increase in a Chinese minority's age at menarche, her hazard of experiencing a first birth increases by 2.4 percent, holding the other independent variables constant.

Table 17: Cox Proportional Hazard Analysis for the Hazard of a First Birth and Menarche for Chinese Minority Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Percent Change
Menarche	0.016*** (0.002) [1.017]	0.015*** (0.002) [1.015]	0.015*** (0.002) [1.015]	0.015*** (0.002) [1.015]	0.025*** (0.002) [1.025]	0.024*** (0.002) [1.024]	2.4
Education	—	-0.022* (0.009) [0.978]	-0.025** (0.009) [0.976]	-0.031*** (0.009) [0.969]	-0.013 (0.009) [0.987]	-0.012 (0.009) [0.988]	-1.2
Rural	—	0.223 (0.122) [1.250]	0.209 (0.122) [1.232]	0.112 (0.122) [1.118]	-0.031 (0.121) [0.970]	-0.044 (0.121) [0.957]	-4.3
Policy	—	—	0.217** (0.083) [1.243]	0.020 (0.086) [1.020]	0.779*** (0.102) [2.177]	0.830*** (0.105) [2.293]	129.3
Fecund	—	—	—	-0.004*** (0.001) [0.996]	-0.003*** (0.001) [0.997]	-0.004*** (0.001) [0.996]	-0.4
Marriage Age	—	—	—	—	-0.026*** (0.001) [0.975]	-0.026*** (0.001) [0.974]	-2.6
Born Before 1961	—	—	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	—	—	-0.279* (0.109) [0.757]	-24.3
Born After 1970	—	—	—	—	—	-0.445** (0.155) [0.641]	-35.9
Pseudo R^2	0.0112	0.0128	0.0135	0.0191	0.0756	0.0764	
Final Log Likelihood	-5127.5062	-5118.8547	-5115.3396	-5086.2409	-4793.5055	-4789.2955	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios *p<0.05 **p<0.01 ***p<0.001

Next, I will discuss the eight Hazard models for the U.S. Non-Hispanic White women.

U.S. NON-HISPANIC WHITE

Table 18 reports the results from eight hazard models for the 6,102 U.S. White women. These analyses include single and ever married women.

Model 1 which includes only age at menarche shows that for every one month increase in menarche age, a woman's hazard of experiencing a first birth increases by 0.1 percent. This is significant at $p<0.01$.

Model 2 incorporates years of education, rural residency, and poverty status as controls. Menarche is again significant and increases. This may be interpreted to indicate that a one month increase in age at menarche will increase the hazard of a first birth by 0.9 percent, controlling for the other variables. This is significant at $p<0.001$.

Adding a control for the number of months a woman is fecund in Model 3 slightly decreases the effect of menarche, but menarche still retains its significance. An additional month increase in age at menarche will increase the hazard of a first birth by 0.6 percent holding the other variables constant

In Model 4, I add parental controls. There is no change in either the value or the significance of the age at menarche variable on the hazard of a first birth.

Religious controls are added in Model 5, and again there is no change in either the value or the significance of age at menarche on the hazard of a first birth. In Model 6, region is added. Adding the region of the U.S. in which the woman lives is not significant and adds nothing to the model. All of the coefficients retain the same values as in Model 5.

Model 7 includes all of the previous controls and adds a control for whether the woman has ever been married. After controlling for all the other variables, one month increase in age at menarche is shown to increase the hazard of a first birth by 0.4 percent.

In the final Model, I control for cohort differences. Women in the cohort born before 1961 are the reference group. Age at menarche retains its significance; for every one month increase, a woman’s hazard of experiencing a first birth increase by 0.3 percent, controlling for the other variables.

Table 18: Cox Proportional Hazard Analysis for the Hazard of a First Birth and Menarche for U.S. Non-Hispanic White Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Menarche	0.008** (0.001) [1.001]	0.009*** (0.001) [1.009]	0.006*** (0.001) [1.006]	0.006*** (0.001) [1.006]	0.006*** (0.001) [1.006]
Education	——	-0.176*** (0.006) [0.839]	-0.171*** (0.007) [0.843]	-0.139*** (0.008) [0.870]	-0.141*** (0.008) [0.869]
Rural	——	0.264*** (0.043) [1.302]	0.253*** (0.043) [1.288]	0.201*** (0.043) [1.223]	0.173*** (0.043) [1.188]
Poverty	——	0.532*** (0.058) [1.702]	0.331*** (0.059) [1.392]	0.318*** (0.059) [1.374]	0.327*** (0.059) [1.387]
Fecund	——	——	-0.006*** (0.000) [0.994]	-0.006*** (0.000) [0.994]	-0.006*** (0.000) [0.994]
Father's Education	——	——	——	-0.022*** (0.006) [0.978]	-0.022*** (0.006) [0.978]
Mother's Education	——	——	——	-0.028*** (0.007) [0.972]	-0.027*** (0.007) [0.973]
Mother Worked	——	——	——	-0.096** (0.034) [0.911]	-0.089** (0.034) [0.915]
Mother's Age at Her First Birth	——	——	——	-0.003*** (0.000) [0.998]	-0.002*** (0.000) [0.998]
No/Other Religion	——	——	——		REFERENCE
Protestant	——	——	——	——	0.257*** (0.051) [1.292]
Catholic	——	——	——	——	0.149** (0.056) [1.161]
Jewish	——	——	——	——	0.281* (0.137) [1.325]
Northwest	——	——	——	——	——
Midwest	——	——	——	——	——
West	——	——	——	——	——
South	——	——	——	——	——
Ever Married	——	——	——	——	——
Born Before 1961	——	——	——	——	——
Born Between 1961 and 1970	——	——	——	——	——
Born After 1970	——	——	——	——	——
Pseudo R^2	0.0013	0.0174	0.0265	0.0288	0.0293
Final Log Likelihood	-28481.343	-28021.547	-27761.29	-27697.044	-27682.418

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

Table 18: Continued

Independent Variable	Model 6	Model 7	Model 8	Percent Change
Menarche	0.006***	0.004***	0.003***	
	(0.001)	(0.001)	(0.001)	0.3
	[1.006]	[1.004]	[1.003]	
	-0.141***	-0.134***	-0.132***	
Education	(0.008)	(0.008)	(0.008)	-12.4
	[0.869]	[0.875]	[0.876]	
Rural	0.179***	0.111*	0.114**	
	(0.044)	(0.044)	(0.044)	12.1
	[1.195]	[1.118]	[1.121]	
Poverty	0.328***	0.489***	0.477***	
	(0.059)	(0.059)	(0.059)	61.1
	[1.388]	[1.631]	[1.611]	
Fecund	-0.006***	-0.008***	-0.009***	
	(0.000)	(0.000)	(0.000)	-0.9
	[0.994]	[0.993]	[0.991]	
Father’s Education	-0.023***	-0.009	-0.004	
	(0.006)	(0.006)	(0.006)	-0.4
	[0.978]	[0.991]	[0.996]	
Mother’s Education	-0.027***	-0.021**	-0.014	
	(0.007)	(0.007)	(0.007)	-1.4
	[0.973]	[0.980]	[0.986]	
Mother Worked	-0.089**	-0.002	-0.025	
	(0.034)	(0.034)	(0.034)	-2.5
	[0.915]	[0.968]	[0.975]	
Mother’s Age at Her	-0.002***	-0.002***	-0.002***	
First Birth	(0.000)	(0.000)	(0.000)	-0.2
	[0.915]	[0.998]	[0.998]	
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	
Protestant	0.262***	0.154**	0.151**	
	(0.051)	(0.051)	(0.051)	16.3
	[1.299]	[1.166]	[1.163]	
Catholic	0.153**	0.094	0.124*	
	(0.057)	(0.057)	(0.057)	13.2
	[1.166]	[1.099]	[1.132]	
Jewish	0.285*	0.199	0.225	
	(0.138)	(0.138)	(0.138)	25.2
	[1.330]	[1.221]	[1.252]	
Northwest	REFERENCE	REFERENCE	REFERENCE	
Midwest	-0.021	-0.036	-0.050	
	(0.050)	(0.050)	(0.050)	-4.9
	[0.980]	[0.965]	[0.951]	
West	0.031	-0.010	-0.016	
	(0.055)	(0.055)	(0.055)	-1.6
	[1.031]	[0.990]	[0.984]	
South	-0.018	-0.053	-0.058	
	(0.051)	(0.051)	(0.051)	-5.6
	[0.983]	[0.949]	[0.944]	
Ever Married	—	1.734***	1.646***	
		(0.072)	(0.745)	418.7
		[5.662]	[5.187]	
Born Before 1961	—	—	REFERENCE	
Born Between 1961 and	—	—	-0.495***	
1970			(0.040)	-39.1
			[0.609]	
Born After 1970	—	—	-0.481***	
			(0.078)	-38.2
			[0.618]	
Pseudo R^2	0.0293	0.0455	0.0482	
Final Log Likelihood	-27681.765	-27220.214	-27142.459	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

Next, I will discuss the results for the U.S. Non-Hispanic Black women.

U.S. NON-HISPANIC BLACK

Table 19 presents results for the eight hazard models for the 2,014 single and ever married U.S. Black women.

Using no control variables in Model 1, the hazard results show that for every one month increase in menarcheal age, a woman’s hazard of experiencing a first birth increases by 1.4 percent. This is significant at $p<0.001$.

Years of education, rural residency, and poverty status do not change the value of menarche, as in Model 2. Menarche remains significant. Adding a control for the number of months a woman is fecund in Model 3 slightly decreases the effect of menarche, but menarche retains its significance. In Model 4, I add the parental controls. An additional month in age at menarche is shown to increase a woman’s hazard of a first birth by 1.1 percent holding the other variables constant. Religion’s influence is added in Model 5 and there is no change in either the value or the significance of age at menarche on the hazard of a first birth. Regional differences are controlled in Model 6.

Adding the region of the U.S. in which the woman lives does not add to the model. All of the coefficients retain the same values as in Model 5.

Model 7 includes all of the previous variables and adds whether the woman has ever been married. After controlling for all the other variables, a one month increase in age at menarche will increase the hazard of a first birth by 1.1 percent.

In the final Model, I control for cohort differences. Age at menarche retains its significance. For every one month increase, a woman’s hazard of experiencing a first birth will increase by 0.8 percent, controlling for the other variables.

Next, I will present the results for the U.S. Mexican-Origin Women.

Table 19: Cox Proportional Hazard Analysis for the Hazard of a First Birth and Menarche for U.S. Non-Hispanic Black Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Menarche	0.014*** (0.001) [1.014]	0.014*** (0.001) [1.014]	0.012*** (0.001) [1.012]	0.011*** (0.001) [1.011]	0.011*** (0.001) [1.011]
Education	____	-0.143*** (0.011) [0.866]	-0.136*** (0.012) [0.873]	-0.116*** (0.012) [0.890]	-0.120*** (0.012) [0.887]
Rural	____	-0.129 (0.109) [0.879]	-0.085 (0.108) [0.919]	-0.162 (0.109) [0.850]	-0.183 (0.110) [0.833]
Poverty	____	0.481*** (0.060) [1.617]	0.403*** (0.060) [1.497]	0.370*** (0.060) [1.447]	0.357*** (0.060) [1.428]
Fecund	____	____	-0.006*** (0.000) [0.994]	-0.007*** (0.000) [0.994]	-0.007*** (0.000) [0.994]
Father's Education	____	____	____	-0.036*** (0.008) [0.965]	-0.034*** (0.009) [0.967]
Mother's Education	____	____	____	-0.010 (0.010) [0.990]	-0.010 (0.010) [0.990]
Mother Worked	____	____	____	-0.037 (0.063) [0.963]	-0.040 (0.063) [0.961]
Mother's Age at Her First Birth	____	____	____	-0.002** (0.001) [0.998]	-0.002** (0.001) [0.998]
No/Other Religion	____	____	____		REFERENCE
Protestant	____	____	____	____	0.192* (0.091) [1.212]
Catholic	____	____	____	____	0.047 (0.134) [1.048]
Northwest	____	____	____	____	____
Midwest	____	____	____	____	____
West	____	____	____	____	____
South	____	____	____	____	____
Ever Married	____	____	____	____	____
Born Before 1961	____	____	____	____	____
Born Between 1961 and 1970	____	____	____	____	____
Born After 1970	____	____	____	____	____
Pseudo R^2	0.0059	0.0216	0.0327	0.0351	0.0354
Final Log Likelihood	-9667.2487	-9514.7735	-9406.3968	-9383.3509	-9380.3146

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

Table 19: Continued

Independent Variable	Model 6	Model 7	Model 8	Percent Change
Menarche	0.011***	0.011***	0.008***	
	(0.001)	(0.001)	(0.001)	0.8
	[1.011]	[1.011]	[1.008]	
	-0.119***	-0.127***	-0.126***	
Education	(0.012)	(0.012)	(0.012)	-11.9
	[0.888]	[0.881]	[0.881]	
Rural	-0.146	-0.144	-0.132	
	(0.112)	(0.122)	(0.876)	12.1
	[0.864]	[0.866]	[1.121]	
Poverty	0.359***	0.466***	0.451***	
	(0.060)	(0.061)	(1.570)	61.1
	[1.432]	[1.594]	[1.611]	
Fecund	-0.007***	-0.007***	-0.009***	
	(0.000)	(0.000)	(0.001)	-0.9
	[0.994]	[0.993]	[0.991]	
Father’s Education	-0.035***	-0.029***	-0.016	
	(0.009)	(0.009)	(0.009)	-1.6
	[0.966]	[0.971]	[0.984]	
Mother’s Education	-0.011	-0.006*	-0.001	
	(0.010)	(0.010)	(0.010)	-0.1
	[0.989]	[0.994]	[0.999]	
Mother Worked	-0.040	0.005	-0.034	
	(0.063)	(0.063)	(0.063)	3.4
	[0.960]	[1.005]	[1.034]	
Mother’s Age at Her	-0.002**	-0.002*	-0.002**	
First Birth	(0.001)	(0.001)	(0.001)	-0.2
	[0.998]	[0.999]	[0.998]	
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	
Protestant	0.208*	0.248**	0.219*	
	(0.092)	(0.092)	(0.092)	24.4
	[1.232]	[1.277]	[1.244]	
Catholic	0.070	0.083	0.122	
	(0.073)	(0.135)	(0.135)	13.0
	[1.166]	[1.086]	[1.130]	
Northwest	REFERENCE	REFERENCE	REFERENCE	
Midwest	0.064	0.062	0.024	
	(0.086)	(0.086)	(0.086)	2.5
	[1.066]	[1.064]	[1.025]	
West	0.090	0.076	0.052	
	(0.110)	(0.110)	(0.110)	5.3
	[1.094]	[1.079]	[1.053]	
South	-0.038	-0.101	-0.119	
	(0.076)	(0.077)	(0.077)	-11.2
	[0.963]	[0.904]	[0.888]	
Ever Married	____	0.570***	-0.397***	
		(0.058)	(0.062)	47.2
		[1.768]	[1.472]	
Born Before 1961	____	____	REFERENCE	
Born Between 1961 and			-0.433***	
1970	____	____	(0.065)	-35.1
			[0.649]	
Born After 1970			-0.885***	
	____	____	(0.112)	-58.7
			[0.413]	
Pseudo R^2	0.0356	0.0407	0.0443	
Final Log Likelihood	-9378.7647	-9328.6221	-9293.3469	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

U.S. MEXICAN-ORIGIN

Table 20 presents the results for nine hazard models for the 827 U.S. Mexican-Origin women.

Model 1 shows that for every one month increase in menarcheal age, a woman’s hazard of experiencing a first birth increases by one percent. This coefficient is significant.

Model 2 adds whether a woman was foreign or native born. An additional month increase in age at menarche will increase a woman’s hazard of a first birth by 0.9 percent controlling for birth location.

After controlling for years of education, rural residency, and poverty status in Model 3, menarche remains significant; an additional month in age at menarche will increase a woman’s hazard of a first birth by 0.7 percent.

The control for the number of month a woman is fecund in Model 4 slightly decreases the effect of menarche, but menarche retains its significance. An additional month increase in age at menarche will increase the hazard of a first birth by 0.5 percent holding the other variables constant.

Parental controls are included in Model 5. An additional month in age at menarche is shown in this model to increase a woman's hazard of a first birth by 0.5 percent holding the other variables constant.

In Model 6, an additional month increase in age at menarche will increase the hazard of a first birth by 0.6 after including a control for religious affiliation.

Region is added to Model 7. Northwest has been dropped and Midwest is the reference group. Adding the region of the U.S. in which the woman lives is not significant. All of the coefficients retain almost identical values as in Model 6.

Marriage is added in Model 8. After controlling for all the other variables, a one month increase in age at menarche is shown to increase the hazard of a first birth by 0.7 percent.

The final Model includes the cohort variables. Age at menarche retains its significance. For every one month increase, a woman's hazard of experiencing a first birth will increase 0.7 percent, controlling for the other variables.

Table 20: Cox Proportional Hazard Analysis for the Hazard of a First Birth and Menarche for U.S. Mexican-Origin Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Menarche	0.010*** (0.002) [1.010]	0.009*** (0.002) [1.009]	0.007** (0.002) [1.007]	0.005* (0.002) [1.005]	0.005* (0.002) [1.005]
Foreign Born	———	0.325*** (0.084) [1.384]	-0.120 (0.100) [0.887]	-0.040 (0.100) [0.961]	-0.098 (0.106) [0.907]
Education	———	———	-0.120*** (0.013) [0.887]	-0.122*** (0.014) [0.885]	-0.113*** (0.015) [0.894]
Rural	———	———	0.662*** (0.174) [1.939[	0.540** (0.174) [1.716]	0.570*** (0.174) [1.768]
Poverty	———	———	0.486*** (0.094) [1.626]	0.340*** (0.094) [1.406]	0.319*** (0.096) [1.378]
Fecund	———	———	———	-0.006*** (0.001) [0.994]	-0.006*** (0.001) [0.994]
Father’s Education	———	———	———	———	-0.012 (0.011) [1.012]
Mother’s Education	———	———	———	———	0.018 (0.013) [0.983]
Mother Worked	———	———	———	———	-0.076 (0.088) [0.983]
Mother’s Age at Her First Birth	———	———	———	———	-0.002** (0.001) [0.998]
No/Other Religion	———	———	———	———	———
Protestant	———	———	———	———	———
Catholic	———	———	———	———	———
Midwest	———	———	———	———	———
West	———	———	———	———	———
South	———	———	———	———	———
Ever Married	———	———	———	———	———
Born Before 1961	———	———	———	———	———
Born Between 1961 and 1970	———	———	———	———	———
Born After 1970	———	———	———	———	———
Pseudo R^2	0.0035	0.0056	0.0252	0.0370	0.0385
Final Log Likelihood	-3463.3977	-3456.0187	-3387.8527	-3346.9597	-3341.62

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

Table 20: Continued

Independent Variable	Model 6	Model 7	Model 8	Model 9	Percent Change
Menarche	0.006**	0.006**	0.007***	0.007***	
	(0.002)	(0.002)	(0.002)	(0.002)	0.7
	[1.006]	[1.006]	[1.007]	[1.007]	
Foreign Born	-0.119	-0.118	-0.212	-0.168	
	(0.106)	(0.107)	(0.108)	(0.108)	-15.4
	[0.888]	[0.889]	[0.809]	[0.846]	
Education	-0.112***	-0.112***	-0.116***	-0.111***	
	(0.015)	(0.015)	(0.015)	(0.015)	-10.5
	[0.894]	[0.894]	[0.980]	[0.895]	
Rural	0.576***	0.580***	0.522**	0.488**	
	(0.175)	(0.175)	(0.176)	(0.176)	62.9
	[1.779]	[1.785]	[1.685]	[1.629]	
Poverty	0.331***	0.326***	0.368***	0.344***	
	(0.096)	(0.097)	(0.098)	(0.098)	41.1
	[1.392]	[1.385]	[1.445]	[1.411]	
Fecund	-0.006***	-0.006***	-0.007***	-0.009***	
	(0.001)	(0.001)	(0.001)	(0.001)	-0.9
	[0.994]	[0.994]	[0.993]	[0.991]	
Father's Education	0.011	0.011	0.016	0.024*	
	(0.011)	(0.011)	(0.011)	(0.012)	2.4
	[1.011]	[1.011]	[1.016]	[1.024]	
Mother's Education	-0.014	-0.014	-0.010	-0.013	
	(0.013)	(0.013)	(0.013)	(0.014)	-1.3
	[0.994]	[0.986]	[0.990]	[0.987]	
Mother Worked	-0.094	-0.090	-0.027	-0.010	
	(0.088)	(0.887)	(0.088)	(0.088)	-1.0
	[0.911]	[0.914]	[0.973]	[0.990]	
Mother's Age at Her First Birth	-0.003**	-0.003**	-0.002	-0.002*	
	(0.001)	(0.001)	(0.001)	(0.001)	-0.2
	[0.998]	[0.998]	[0.998]	[0.998]	
No/Other Religion	REFERENCE	REFERENCE	REFERENCE	REFERENCE	
Protestant	0.369	0.362	0.433*	0.518**	
	(0.192)	(0.194)	(0.195)	(0.199)	67.8
	[1.446]	[1.437]	[1.542]	[1.678]	
Catholic	0.337	0.334	0.437*	0.526**	
	(0.174)	(0.174)	(0.176)	(0.180)	69.2
	[1.401]	[1.396]	[1.548]	[1.692]	
Midwest	____	REFERENCE	REFERENCE	REFERENCE	
West	____	0.031	-0.050	-0.097	
		(0.167)	(0.167)	(0.168)	-9.2
		[1.032]	[0.951]	[0.908]	
South	____	0.075	-0.045	-0.088	
		(0.175)	(0.176)	(0.176)	-8.4
		[1.078]	[0.956]	[0.916]	
Ever Married	____	____	0.854***	0.836***	
			(0.122)	(0.128)	130.8
			[2.349]	[2.308]	
Born Before 1961	____	____	____	REFERENCE	
Born Between 1961 and 1970	____	____	____	-0.439***	
				(0.105)	-35.5
				[0.645]	
Born After 1970	____	____	____	-0.464**	
				(0.168)	-37.1
				[0.629]	
Pseudo R^2	0.0392	0.0392	0.0475	0.0500	
Final Log Likelihood	-3339.3946	-3339.2409	-3310.5031	-3301.7677	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

DISCUSSION

Age at menarche is consistently significant and positive for all five groups in predicting the hazard of a first birth. As a woman's age at menarche increase, her hazard of experiencing a first birth also increases. The fact that age at menarche is not the most important variable in the models is not that central for my dissertation. The important point is that it is significant after controlling for numerous social variables.

The effects of menarche on the hazard of a first birth appear to be stronger for Chinese women than for U.S. women. For the Han women, as they get older when reaching menarche, their hazard of a first birth is 3.6 percent and for the Chinese minority women, it is 2.4 percent. But, for the U.S. women, the hazard is less than one percent.

The next chapter will discuss the results of my Poisson Regression and Negative Binominal models estimating the effect of age at menarche on the number of children ever born (CEB).

CHAPTER VII

CHILDREN EVER BORN

In this chapter, I will discuss my results for the dependent variable of Children Ever Born. The dependent variable is a count variable, so I will first estimate the full model using Negative Binomial regression. This will enable me to determine if there is evidence of overdispersion in the model. If the alpha coefficient is significant, this means that there is a significant amount of overdispersion and Negative Binominal regression would be appropriate (Long and Freese 2001: 247). If the alpha coefficient is not significant, the model is reduced to the Poisson Regression model. After estimating Negative Binominal models for all my groups, I have determined that Poisson is the appropriate method for the two groups of Chinese women and Negative Binominal regression is appropriate for the three groups of U.S. women. I will first report the Poisson regression results for the Chinese Han women and then for the Chinese Minority women. Next, I will report the Negative Binominal regression results for the U.S. White, U.S. Black, and U.S. Mexican-Origin women.

In my tables, numbers in parentheses are the standard errors and the numbers in brackets are the incidence rate ratios. The ratios are derived by exponentiating the coefficients. This leads to a more intuitive interpretation. I will use the incidence rate ratios in my discussions.

CHINESE HAN

Table 21 reports the Poisson regression results for the 10,879 ever married Chinese Han women.

In Model 1, I include only menarche; it is positive and significant. Chinese Han women will produce on average 0.7 percent more children for every month increase in their age at menarche. Since this is multiplicative, I can convert this to years and say that for every year older the women are at menarche, they will have 0.84 more children ever born.

In Model 2, I add education level and rural residency; menarche remains significant and positive. But it does lose some of it influence; for every additional month older at menarche, Han women will on average have 0.4 percent more children. Model three controls for the effects of the one child policy and menarche remains significant and positive.

Model 4 adds a control for months fecund and menarche actually increases its influence from the previous model. After adding the woman's age at first marriage in Model 5, menarche again gains value and remains significant; for every month older Chinese Han women are when reaching menarche their mean number of children ever born increase by 0.5 percent.

Model 6 is the final model and includes controls for cohort membership. Women born before 1961 are the reference group. Menarche remains significant and positive. The final column, based on Model 6, reflects percent change calculations for every independent variable in the number of children ever born. After controlling for all the other variables, Han women will increase their average CEB by 0.2 percent for every month they are older when reaching menarche. While menarche is not the most influential variable (membership in the youngest cohort is), important to this dissertation is that it is significant and positive. Also, it is more important than education, fecundity, and age at marriage.

Next, I will discuss my Poisson regression results for the Chinese minority women.

Table 21: Poisson Regression Analysis of Children Ever Born and Menarche for Chinese Han Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Percent Change
Menarche	0.007*** (0.000) [1.007]	0.004*** (0.000) [1.004]	0.003*** (0.000) [1.003]	0.004*** (0.000) [1.004]	0.005*** (0.000) [1.005]	0.002*** (0.000) [1.002]	0.2
Education	—	-0.044*** (0.002) [0.957]	-0.035*** (0.002) [0.965]	-0.034*** (0.002) [0.966]	-0.027*** (0.002) [0.973]	-0.019*** (0.002) [0.981]	-1.9
Rural	—	0.217*** (0.022) [1.243]	0.256*** (0.022) [1.291]	0.329*** (0.022) [1.390]	0.259*** (0.023) [1.296]	0.281*** (0.023) [1.324]	32.4
Policy	—	—	-0.246*** (0.016) [0.782]	-0.171*** (0.017) [0.843]	-0.085*** (0.018) [0.918]	0.094*** (0.021) [1.099]	9.9
Fecund	—	—	—	0.001*** (0.000) [1.001]	0.002*** (0.000) [1.002]	0.000** (0.000) [1.000]	0.0
Marriage Age	—	—	—	—	-0.005*** (0.000) [0.995]	-0.005*** (0.000) [0.994]	-0.6
Born Before 1961	—	—	—	—	—	REFERENC	
Born Between 1961 and 1970	—	—	—	—	—	-0.372*** (0.022) [0.690]	-31.0
Born After 1970	—	—	—	—	—	-0.965*** (0.033) [0.381]	-51.9
Constant	-0.717	-0.007	0.196	-0.299	0.657	1.698	
Pseudo R^2	0.0143	0.0463	0.0537	0.0599	0.0724	0.1006	
Final Log Likelihood	-16008.089	-15489.254	-15369.129	-15268.901	-15065.77	-14606.402	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios *p<0.05 **p<0.01 ***p<0.001

CHINESE MINORITY

Table 23 reports the results of the Poisson regression analysis for the 939 ever married Chinese Minority Women.

In Model 1, menarche is significant and positive; for every month older the Chinese minority women are at menarche their mean CEB is increases by 0.5 percent. After adding education and rural residency in Model 2, the effect of menarche decreases; this means that after controlling for the other two variables, a month increase in age at menarche will increase CEB by 0.3 percent. Adding policy in Model 3 does not change the effect of menarche nor its significance. Model 4 includes all the previous variables and adds fecundity. Menarche remains significant and increases slightly in value; a month increase in age at menarche will increase the mean CEB by 0.4 percent. Model 5 controls for age at first marriage and menarche remains significant and again increases slightly.

Model 6 is the final model and includes all the variables including cohort membership. Menarche is positive and significant. The final column is the percent change in CEB based on Model 6. The average CEB will increase by 0.4 percent with every month increase in age at menarche for Chinese minority women. Again, menarche is not the most influential variable, but of concern to this dissertation is that it is significant and as predicted, positive.

Next, I will discuss my Negative Binominal regression results for the U.S. women. These analyses will include six models for the White women and Black women and seven models for the Mexican-Origin women. I will not control for whether the woman has been ever married because, in the U.S., childbearing is not limited to marriage. I do not want to omit childbearing that is occurring outside of marriage. Also, I will not include the cohort variables. These variables are designed to control for age related effects. But in the models, I have already controlled for age, twice, once with age at menarche and again with fecund. I fear that to include another age related variable I may well be over controlling for age effects and changing the effects of menarche.

Table 22: Poisson Regression Analysis of Children Ever Born and Menarche for Chinese Minority Women, 1997

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Percent Change
Menarche	0.005*** (0.001) [1.005]	0.003** (0.001) [1.003]	0.003** (0.001) [1.003]	0.004*** (0.001) [1.004]	0.006*** (0.001) [1.006]	0.004*** (0.001) [1.004]	0.4
Education	—	-0.030*** (0.006) [0.971]	-0.023*** (0.006) [0.978]	-0.023*** (0.006) [0.977]	-0.018** (0.006) [0.982]	-0.017** (0.006) [0.983]	-1.7
Rural	—	0.199* (0.087) [1.220]	0.244** (0.087) [1.276]	0.365*** (0.088) [1.441]	0.316*** (0.088) [1.371]	0.308*** (0.088) [1.361]	36.1
Policy	—	—	-0.367*** (0.047) [0.693]	0.001 (0.056) [1.001]	0.167* (0.061) [1.182]	0.244*** (0.070) [1.276]	27.6
Fecund	—	—	—	0.004*** (0.000) [1.004]	0.004*** (0.000) [1.004]	0.002*** (0.000) [1.002]	0.2
Marriage Age	—	—	—	—	-0.006*** (0.001) [0.994]	-0.007*** (0.001) [0.994]	-0.6
Born Before 1961	—	—	—	—	—	REFERENCE	
Born Between 1961 and 1970	—	—	—	—	—	-0.340*** (0.074) [0.712]	-28.8
Born After 1970	—	—	—	—	—	-0.933*** (0.108) [0.393]	-60.7
Constant	-0.111	0.161	0.345	-0.959	-0.044	1.177	
Pseudo R^2	0.0073	0.0219	0.0402	0.0943	0.1205	0.1445	
Final Log Likelihood	-1617.8373	-1594.1014	-1564.1515	-1476.0391	-1433.4031	-1394.1503	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios *p<0.05 **p<0.01 ***p<0.001

U.S. NON-HISPANIC WHITE

Table 23 reports the results for the 6,102 single and ever married U.S. White women.

In Model 1, which includes only menarche, it is not significant and is negative, which is opposite to what is predicted. Model 2 adds education, rural residency and poverty and menarche remains negative and is not significant. But in Model 3, after adding fecundity, menarche is positive as predicted and becomes significant; an additional month older at menarche will increase White women’s mean CEB by 0.3 percent after controlling for the other variables. After adding parental influence in Model 4, menarche remains significant and positive. Adding religious affiliation in Model 5 and region in Model 6 does not improve the model or the value of menarche; for every one month increase in age at menarche for White women, their average CEB will increase by 0.2 percent. This is reflected in the final column of the table. Again, menarche is not the most important variable, but its significance is maintained when adding the social variables.

Next, I will discuss the Negative Binomial results for the U.S. Black women.

Table 23: Negative Binominal Regression Analysis of Children Ever Born and Menarche for U.S. Non-Hispanic White Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4
Menarche	-0.001 (0.001) [0.999]	-0.001 (0.001) [0.999]	0.003*** (0.001) [1.003]	0.002** (0.001) [1.002]
Education	___	-0.024*** (0.006) [0.976]	-0.074*** (0.006) [0.929]	-0.038*** (0.006) [0.963]
Rural	___	0.172*** (0.035) [1.188]	0.183*** (0.033) [1.120]	0.122*** (0.033) [1.130]
Poverty	___	0.157*** (0.046) [1.170]	0.311*** (0.044) [1.364]	0.284*** (0.043) [1.328]
Fecund	___	___	0.004*** (0.000) [1.004]	0.004*** (0.000) [1.004]
Father’s Education	___	___	___	-0.028*** (0.005) [0.972]
Mother’s Education	___	___	___	-0.029*** (0.006) [0.972]
Mother Worked	___	___	___	-0.168*** (0.026) [0.846]
Mother’s Age at Her First Birth	___	___	___	-0.002*** (0.000) [0.998]
No/Other Religion	___	___	___	___
Protestant	___	___	___	___
Catholic	___	___	___	___
Jewish	___	___	___	___
Northwest	___	___	___	___
Midwest	___	___	___	___
West	___	___	___	___
South	___	___	___	___
Constant	0.400	0.631	-0.153	0.946
Pseudo R^2	0.0001	0.0038	0.0359	0.0497
Final Log Likelihood	-9234.1079	-9199.9102	-8903.9939	-8776.0131

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios

*p<0.05 **p<0.01 ***p<0.001

Table 23: Continued

Independent Variable	Model 5	Model 6	Percent Change
Menarche	0.002**	0.002**	0.2
	(0.001)	(0.001)	
	[1.002]	[1.002]	
Education	-0.038***	-0.038***	-3.7
	(0.006)	(0.006)	
	[0.965]	[0.963]	
Rural	0.104**	0.111***	11.8
	(0.033)	(0.033)	
	[0.963]	[1.118]	
Poverty	0.296***	0.296***	34.4
	(0.043)	(0.043)	
	[1.109]	[1.344]	
Fecund	0.004***	0.004***	0.4
	(0.000)	(0.000)	
	[1.004]	[1.004]	
Father’s Education	-0.028***	-0.028***	-2.8
	(0.004)	(0.005)	
	[0.973]	[0.972]	
Mother’s Education	-0.028***	-0.029***	-2.9
	(0.006)	(0.006)	
	[0.972]	[0.971]	
Mother Worked	-0.167***	-0.165***	-15.2
	(0.026)	(0.026)	
	[0.847]	[0.848]	
Mother’s Age at Her First Birth	-0.002***	-0.002***	-0.2
	(0.000)	(0.000)	
	[0.998]	[0.998]	
No/Other Religion	REFERENCE	REFERENCE	
Protestant	0.219***	0.230***	25.9
	(0.039)	(0.040)	
	[1.245]	[1.259]	
Catholic	0.174***	0.175***	19.2
	(0.043)	(0.044)	
	[1.190]	[1.192]	
Jewish	0.149	0.153	16.5
	(0.107)	(0.108)	
	[1.160]	[1.165]	
Northwest	___	REFERENCE	
Midwest	___	-0.010	-10.0
		(0.038)	
		[0.990]	
West	___	0.024	2.4
		(0.042)	
		[1.024]	
South	___	-0.055	-5.3
		(0.039)	
		[0.947]	
Constant	0.781	0.823	
Pseudo R^2	0.0515	0.0517	
Final Log Likelihood	-8759.9222	-8757.5297	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios

*p<0.05 **p<0.01 ***p<0.001

U.S. NON-HISPANIC BLACK

Table 24 reports the results for the 2,014 single and ever married U.S. Black women.

Menarche is significant and positive in Model 1; each additional month older at menarche increases Black women's average CEB by 0.3 percent. Adding education, rural residency and poverty in Model 2 does not change either the significance or the value of menarche. In Model 3, I add fecundity and the value of menarche slightly increases. Adding parental influences in Model 4 decreases menarche's value, but it remains significant; a one month increase in Black women's age at menarche increases their mean CEB by 0.2 percent. Adding religion in Model 5 increases the influence of menarche; an additional month older at menarche will increase CEB by 0.3 percent.

Model 6 is the full model and includes region. This is not an improvement over the previous model. The final column reports the percent change in CEB. Black women's average CEB will increase by 0.3 percent for every month older they are when reaching menarche. This is significant and as predicted.

Next, I will discuss the Negative Binomial results for the U.S. Mexican-Origin women.

Table 24: Negative Binominal Regression Analysis of Children Ever Born and Menarche for U.S. Non-Hispanic Black Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4
Menarche	0.003** (0.001) [1.003]	-0.003** (0.001) [1.003]	0.004*** (0.001) [1.004]	0.002** (0.001) [1.003]
Education	———	-0.046*** (0.009) [0.955]	-0.066*** (0.010) [0.928]	-0.036*** (0.010) [0.964]
Rural	———	-0.091 (0.082) [0.913]	-0.111 (0.082) [0.895]	-0.198* (0.080) [0.821]
Poverty	———	0.388*** (0.044) [1.474]	0.415*** (0.044) [1.515]	0.371*** (0.042) [1.449]
Fecund	———	———	0.002*** (0.000) [1.002]	0.001*** (0.000) [1.001]
Father's Education	———	———	———	-0.032*** (0.006) [0.969]
Mother's Education	———	———	———	-0.032*** (0.007) [0.968]
Mother Worked	———	———	———	-0.093* (0.046) [0.912]
Mother's Age at Her First Birth	———	———	———	-0.002*** (0.000) [0.999]
No/Other Religion	———	———	———	———
Protestant	———	———	———	———
Catholic	———	———	———	———
Northwest	———	———	———	———
Midwest	———	———	———	———
West	———	———	———	———
South	———	———	———	———
Constant	0.046	0.500	0.241	1.324
Pseudo R^2	0.0011	0.0210	0.0264	0.0449
Final Log Likelihood	-3339.8683	-3273.5067	-3255.2484	-3193.5387

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

Table 24: Continued

Independent Variable	Model 5	Model 6	Percent Change
Menarche	0.003**	0.003**	0.3
	(0.001)	(0.001)	
	[1.003]	[1.003]	
Education	-0.037***	-0.037***	-3.6
	(0.010)	(0.010)	
	[0.963]	[0.964]	
Rural	-0.210**	-0.181*	-16.5
	(0.080)	(0.082)	
	[0.811]	[0.835]	
Poverty	0.366***	0.364***	43.9
	(0.042)	(0.042)	
	[1.442]	[1.439]	
Fecund	0.001***	0.001***	0.1
	(0.000)	(0.000)	
	[1.001]	[1.001]	
Father's Education	-0.031***	-0.031***	-3.1
	(0.006)	(0.006)	
	[0.970]	[0.969]	
Mother's Education	-0.032***	-0.032***	-3.2
	(0.007)	(0.007)	
	[0.969]	[0.968]	
Mother Worked	-0.098*	-0.099*	-9.4
	(0.046)	(0.045)	
	[0.907]	[0.906]	
Mother's Age at Her First Birth	-0.002***	-0.002***	-0.1
	(0.000)	(0.000)	
	[0.999]	[0.999]	
No/Other Religion	REFERENCE	REFERENCE	
Protestant	0.144*	0.143*	15.4
	(0.066)	(0.067)	
	[1.155]	[1.154]	
Catholic	0.068	0.074	7.7
	(0.100)	(0.100)	
	[1.070]	[1.077]	
Northwest	——	REFERENCE	
Midwest	——	0.091	9.5
		(0.062)	
		[1.095]	
West	——	0.013	1.3
		(0.082)	
		[1.013]	
South	——	-0.011	-1.1
		(0.056)	
		[0.989]	
Constant	1.208	1.190	
Pseudo R^2	0.0457	0.0463	
Final Log Likelihood	-3190.8294	-3188.6376	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios

*p<0.05 **p<0.01 ***p<0.001

U.S. MEXICAN-ORIGIN

In Table 25, I report my results of the Negative Binomial regression for the 827 single and ever married Mexican-Origin women.

In Model 1, I include only menarche and it is positive, but not significant. After controlling for foreign birth in Model 2, menarche is still not significant and becomes negative. In Model 3, I add years of education, rural residency, and poverty status and menarche becomes significant, but is negative, which is opposite of what I predicted; an additional month older at menarche decreases Mexican-Origin women’s average CEB by 0.3 percent. In Model 4, I add fecundity and menarche remains negative, but is not significant. After adding parental influences in Model 5, religion in Model 6, and region in Model 7, menarche remains negative and not significant. This indicates that a Mexican-Origin woman’s age at menarche does not have a statistically significant effect on her CEB.

Some research indicates that Mexican-Origin women who are born in the U.S. and have assimilated will have rates closer to those of Non-Hispanic Whites (Torres Forthcoming). Therefore, I have run models for only those women who were born in the U.S. The results do not differ from the results obtained for all Mexican-Origin women. One reason may be that I need additional controls for the number of generations removed from foreign birth and miles from the boarder. Each of these variables, along with other Mexican-Origin specific variables, could alter my results.

Next, I will discuss the similarities and differences between the five groups.

Table 25: Negative Binominal Regression Analysis of Children Ever Born and Menarche for U.S. Mexican-Origin Women, 1995

Independent Variable	Model 1	Model 2	Model 3	Model 4
Menarche	0.001 (0.002) [1.001]	-0.002 (0.002) [0.998]	-0.003* (0.002) [0.997]	-0.001 (0.002) [0.999]
Foreign Born	____	0.456*** (0.064) [1.578]	0.279*** (0.066) [1.322]	0.168** (0.064) [1.183]
Education	____	____	-0.062*** (0.010) [0.940]	-0.069*** (0.009) [0.934]
Rural	____	____	0.201 (0.119) [1.223]	0.301** (0.113) [1.351]
Poverty	____	____	0.257*** (0.063) [1.293]	0.365*** (0.061) [1.351]
Fecund	____	____	____	0.004*** (0.000) [1.004]
Father's Education	____	____	____	____
Mother's Education	____	____	____	____
Mother Worked	____	____	____	____
Mother's Age at Her First Birth	____	____	____	____
No/Other Religion	____	____	____	____
Protestant	____	____	____	____
Catholic	____	____	____	____
Midwest	____	____	____	____
West	____	____	____	____
South	____	____	____	____
Constant	0.473	0.653	1.487	0.577
Pseudo R^2	0.0001	0.0359	0.0411	0.0737
Final Log Likelihood	-1484.1201	-8903.9939	-1423.2408	-1374.9358

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios

*p<0.05 **p<0.01 ***p<0.001

Table 25: Continued

Independent Variable	Model 5	Model 6	Model 7	Percent Change
Menarche	-0.002	-0.002	-0.002	-0.1
	(0.002)	(0.002)	(0.002)	
	[0.999]	[0.999]	[0.999]	
Foreign Born	0.086	0.082	0.076	7.9
	(0.067)	(0.067)	(0.068)	
	[1.090]	[1.085]	[1.079]	
Education	-0.052***	-0.052***	-0.052***	-5.0
	(0.010)	(0.010)	(0.010)	
	[0.950]	[0.950]	[0.950]	
Rural	0.295**	0.298**	0.308**	36.1
	(0.112)	(0.113)	(0.114)	
	[1.343]	[1.347]	[1.361]	
Poverty	0.323***	0.330***	0.332***	60.7
	(0.061)	(0.061)	(0.062)	
	[1.382]	[1.391]	[1.393]	
Fecund	0.003***	0.003***	0.003***	0.3
	(0.000)	(0.000)	(0.000)	
	[1.003]	[1.003]	[1.003]	
Father’s Education	-0.010	-0.010	-0.010	-10.0
	(0.007)	(0.007)	(0.007)	
	[0.990]	[0.990]	[0.990]	
Mother’s Education	-0.014	-0.014	-0.014	-1.3
	(0.009)	(0.009)	(0.009)	
	[0.986]	[0.996]	[0.987]	
Mother Worked	-0.085	-0.093	-0.095	-9.1
	(0.060)	(0.060)	(0.060)	
	[0.918]	[0.911]	[0.909]	
Mother’s Age at Her First Birth	-0.002**	-0.002**	-0.002*	-0.1
	(0.001)	(0.001)	(0.001)	
	[0.998]	[0.998]	[0.999]	
No/Other Religion	——	REFERENCE	REFERENCE	
Protestant	——	0.189	0.198	21.9
		(0.123)	(0.124)	
		[1.209]	[1.219]	
Catholic	——	0.151	0.157	17.0
		(0.112)	(0.113)	
		[1.163]	[1.170]	
Midwest	——	——	REFERENCE	
West	——	——	0.102	10.8
			(0.115)	
			[1.108]	
South	——	——	0.069	7.2
			(0.120)	
			[1.072]	
Constant	1.177	1.021	0.930	
Pseudo R^2	0.0812	0.0820	0.0823	
Final Log Likelihood	-1363.8054	-1362.5786	-1362.1032	

Note: Numbers in parentheses are standard errors; numbers in brackets are Hazard Ratios
*p<0.05 **p<0.01 ***p<0.001

DISCUSSION

Age at menarche has a positive and a significant independent influence on the number of children a woman will produce for all the groups analyzed in this chapter except the U.S. Mexican-Origin women. The older the woman at menarche, the more children she will have born to her in her lifetime. In both China and the U.S. the effect for the two majority groups, Han and White, is the same (0.2 percent); age at menarche has a slightly higher effect on the number of children ever born for the minority groups in China (0.4 percent) and Black women in the U.S. (0.3 percent).

The effect of age at menarche for the U.S. Mexican-Origin women is negative and not significant. While these results may be surprising, it is not unprecedented in demography, especially when examining demographic processes associated with the Mexican-Origin population, such as infant mortality rates. The “epidemiological paradox” associated with the Mexican-Origin population is well documented (see Hummer etal 1999; Bradshaw and Frisbie 1992; Forbes and Frisbie 1991; Rogers 1989) and the unknown variables influencing infant mortality rates and other rates may well be influencing my results. This will be discussed further in the next chapter.

In my next chapter, I will discuss my findings, implications of this dissertation, and finally make suggestions for future research.

CHAPTER VII

DISCUSSION AND CONCLUSION

In this chapter, I briefly review the findings of my dissertation and their implications regarding biology. Next, I discuss the general implications of this research. Finally, I put forth some suggestions for future research about age at menarche.

FINDINGS

Using data from two different nationally representative samples from China and the U.S., I have demonstrated in this dissertation that after controlling for relevant social factors, a woman’s age at menarche significantly and positively influences her age at first birth, her hazard of a first birth, and, except for the U.S. Mexican-Origin women, her number of children ever born. I use data on five distinct cultures; Chinese Han, Chinese minorities, U.S. Whites, U.S. Blacks, and U.S. Mexican-Origin.

My findings are grounded in biological and social reasoning that is consistent with prior research. Biologically, women who reach menarche at a later age have a shorter period of subfecundity and are thus more likely to experience a first birth sooner after reaching menarche than women with an early age at menarche. My findings support this hypothesis. A woman’s age at her first birth increases only a fraction of a month for each additional month when reaching menarche. Also, her chance of having a first birth and having it sooner increases.

A woman who reaches menarche early is likely to waste many of her more viable follicles before she is ready to conceive, and her ovulation cycles are spaced further apart. Therefore, if menarche is postponed, the woman’s chances of conception increase and, as I have demonstrated, she will produce more children. All of the groups of women’s mean numbers of children ever born were shown to increase as their ages at menarche increases except for the Mexican-Origin women. An unmeasured variable influencing infant mortality rates of these women, the “epidemiological paradox”, may well be influencing my results.

The “paradox” is not found among all Hispanic groups. It is limited to Hispanics of Mexican-Origin and is more pronounced among those who reside close to the U.S.-Mexican boarder and/or are recent immigrants to the U.S. Many of the models used when conducting research among Hispanic populations are based on Non-Hispanic findings without considering the uniqueness of the Hispanic situation. Most studies, including this dissertation, include independent variables, such as SES, that are standard in the literature, and are predicted to that affect health outcomes. These variables often predict that Mexican-Origin people should experience outcomes that are lower than the Non-Hispanic white population. But, in addition to infant mortality rates, Mexican-Origin women typically do not give birth to infants with low birth weights as would be predicted (Hayes-Baustista 2002). Also, mortality among the Mexican-Origin population differs from that predicted. Hispanic crude death rates are only about 80 percent of Non-Hispanic whites, and their rates for the top causes of death are lower than those for Whites. The rates for heart disease, cancer, and stroke (the top three causes of death in the U.S.) for the Hispanic population are well below those of the Non-Hispanic White population (Hayes-Baustista 2002). As immigrants acculturate, their rates are expected to become closer to those of the Non-Hispanic White population (Torres Forthcoming). Therefore, many researchers urge that models need to be developed for Hispanics that examine the uniqueness of their culture and circumstances. My results offer one more part of the puzzle for Mexican-Origin population distinctiveness. More research needs to be conducted that will examine this difference within the Mexican-Origin population.

I have demonstrated the effects of the interaction between environment and biology. In an environment that has strong social controls over its members’ behavior, a biological variable’s influence on the behavior should be less than in an environment that exerts less social control (Udry 1995). Therefore, the effect of menarche should be stronger in the U.S. than in China, and the effect should be weaker among Han and Non-Hispanic White women than among any of the minority women.

The effects of menarche on age at first birth were shown to be smaller for the Chinese women than for the U.S. women and, the effect was smaller for Chinese Han than for Chinese Minority women. But, in the U.S., it would appear that Non-Hispanic Black women experience more social control than Non-Hispanic White women. This is so because the effect of menarche is stronger among Non-Hispanic White women, and Mexican-Origin women appear to have the least amount of social control exerted from their environment because the effect of menarche on age at first birth is stronger for them.

The effects of menarche on the hazard of a first birth are more consistent with Udry' theory for the U.S. Menarche's effect is smallest for Non-Hispanic White women, slightly larger for Mexican-Origin women, and largest for Non-Hispanic Black women. Also, the effect of menarche is stronger in China than in the U.S. But, the effect is stronger for Chinese Han women than Chinese minority women.

The effect of menarche on CEB is stronger for Chinese minority women than Chinese Han women and slightly stronger for U.S. Non-Hispanic Black women than for Non-Hispanic White women. But, the effect is not different for Chinese Han compared to U.S. Non-Hispanic White women. The effect is strongest for Chinese minority women, which suggests that they may have less social control in relation to CEB than among the other groups.

The results of menarche and CEB for Mexican-Origin women suggest that they are subjected to an enormous amount of social control to the point that the "biologically based variance [has] shrunk to the vanishing point" (Udry 1995: 353). This could assist us in explaining the insignificance of menarche on CEB for this group of women.

IMPLICATIONS

Most demographic and sociological research does not include biological variables despite that fact that two of the key dependent variables of demography, fertility and mortality, have obvious ties and linkages with biology (Poston, 2000). But, I have demonstrated that a biological variable such as age at menarche has an important and statistically significant effect on fertility behavior, even after controlling for relevant social factors.

Consider a hypothetical equation, proposed by Casterline (1995):

$$D_i = hB_i + sS_i + c(B_i * S_i) + e_i$$

where: *D* is some demographic outcome, such as fertility, *B* is a vector of biological variables, including a variable such as age at menarche, *S* is a vector of social variables, *h* and *s* are vectors of parameters to be estimated indicating the effects of the biological and social variables, *e* is an error term, and the subscript *i* refers to individual women (Casterline, 1995: 360).

In the first place, much of demography assumes the parameter *h* not to be significantly different from zero. Casterline has stated, and we agree, that the “denial of the existence of parameter *h* ... [is] now amply refuted by empirical scientific evidence. As scientists we must acknowledge that a substantial and solid body of evidence supports the proposition that individual variation in many behaviors is biologically driven" (Casterline, 1995: 361).

Biosocial models need not be incorporated in all demographic studies. "A large fraction of the central research questions in social demography concerns secular change and or macro/societal variation, and hence it is not clear that much attention need be given [in such analyses] to biological variables" (Casterline, 1995: 368). The role of biosocial models in demography thus depends greatly on the demographic outcome being investigated.

The literature on age at menarche has clearly shown that increases in modernization in a society lead to decreases in women's average age at menarche. In the United States, and in other Northern European countries, the average age at menarche has decreased by about two years in the past one hundred years (Pollard 1994). There is evidence that the decline has slowed and perhaps even stopped (Wood, 1994; 423). Some have argued that the secular decline is due largely to such features of modernization as better nutrition and healthier lifestyles

(Frisch 1988; Wahrenforf 1993). Others place more importance on decreases in the “prevalences of infectious disease and decreased consanguinity” (Wood 1994: 416).

My dissertation results provide some relevance for the impacts of modernization on social behavior, particularly, fertility behavior. Modernization is the key feature of demographic transition theory, which argues that social and economic development has direct effects, and indirect effects on fertility. Modernization is typically viewed as providing an aggregate setting which influences fertility directly. Blake (1973) noted many years ago that social and economic structures and institutions tend to influence reproductive motivation and fertility by specifying the reward structures related with childbearing (also see Hernandez, 1984: 11-13). Mason has written that demographic transition “theory attributes fertility decline to changes in social life that accompany, and are presumed to be caused by, industrialization and urbanization. These changes initially produce a decline in mortality, which sets the stage for – or by itself may bring about – fertility decline by increasing the survival of children, and hence the size of families” (Mason, 1997: 444). Ceremonies marking the transition to “adulthood”, such as the Quinceaneras and “coming out parties”, are part of the social structure. Since social structures influence fertility behavior, it stands to reason that the “social” behavior of fertility, namely a first birth and number of children ever born, is rooted in a biological function. But, to date, the fertility-reduction effects of modernization have not been represented as including any biological causes.

The mechanisms of modernization are seen in most sociological and demographic studies. Education is viewed as one indicator of modernization. As education increases, SES increases. This leads to fewer children, better health, and higher standards of living. Higher education also contributes to the labor force participation of women. As women gain more education, they are more likely to participate in the paid labor force. This means that they have less time to devote to a family. The end result is usually fewer children.

Most modernization occurs during the shift from a rural population to an urban population. At the beginning of the 20^{th} century, most of the U.S. population lived in rural areas, much like China today. As farming techniques modernized and factories emerged in the cities, there was extensive migration from rural to urban areas, where a great majority of Americans now live. This transition has a negative effect on fertility. No longer do families require a large number of children to ensure that farm work is completed. Children become a liability in urban settings because they no longer contribute to the family with labor and/or money.

Menarche is another mechanism of modernization. My results would appear to allow one to extend modernization theory and its fertility-reduction effects to include age at menarche. For not only will increases in modernization result in lower fertility, but these increases will also lead to lower fertility because of a lowering of women's age at menarche. But, the decreasing age at menarche may lead to a decreasing age at first birth, which is often not desirable. Stricter marriage laws could remedy this negative effect in countries such as China where almost all childbearing is within marriage. However, countries such as the U.S., where marriage is not necessarily a normative prerequisite for a first birth, could face additional problems of teenage pregnancy, low birth weight, and higher teen infant mortality rates.

My demonstrations of a positive association between age at menarche and fertility behavior thus tend to expand demographic transition theory by incorporating a biological variable that is directly affected by modernization. Therefore, the negative effects of modernization on fertility are enhanced.

FUTURE RESEARCH

There are numerous ways to extend this research. The most obvious is to examine the interaction effects between the variables. As I have already theorized, there is likely a positive relationship between social control and biology; another method would be to test the interaction effects among the independent variables. The results reported in this dissertation pertain to direct, or main, effects of age at menarche and the other covariates on a woman's fertility behavior. It may well be the situation that the effects on age at first birth, the hazard of a first birth and CEB of the age at menarche independent variable may vary according to the magnitude of one or more of the other independent variables. Thus in addition to examining the main effects of age at menarche on fertility, I might also ask if age at menarche has an effect on fertility when it is interacting with another of the independent variables. It may be, for instance, that the positive effect of age at menarche on fertility behavior is stronger for women who reside in rural areas compared to women who reside in urban areas.

The calculation of simple product terms involving the appropriate independent variables would enable me to test for the presence of interaction effects, or what some refer to as moderated relationships. Thus, for example, I could multiply for each woman her residency status by her age at menarche; the multiplicative term of the woman's residency times her age at menarche is then treated as another independent variable in the regression equations. If there is an effect on fertility behavior involving the interaction of age at menarche with rural or urban residency, that is, if the effect on fertility behavior of age at menarche is mediated by the woman's residency in a rural or urban area, then this multiplicative term will be statistically significant. The use of simple product terms is but one of many ways to test for interaction effects, but is one of the more common statistical approaches (Jaccard et al. 1990: 22-24). I would then multiply each of the independent variables by age at menarche and run the models again with these new variables added.

A second suggestion would be to recode age at menarche into quartiles. Using the mean age at menarche, such as twelve in the U.S., I could code the women into quartiles and then run the regression using one of the quartiles as the reference group. This would enable me to see if the variation is greater for those in either the lowest or highest quartiles. It may be that only those women with older ages at menarche have higher CEB or that those younger at menarche are younger at their first birth.

One concern about using survey data is the accuracy of recalling past events such as age at menarche. One solution would be to obtain complete fertility histories by following women from menarche to menopause. While no data are currently available with these types of longitudinal capabilities, this would be the optimal situation.

Another concern for the study of fertility, especially when examining different countries, such as the U.S. and China, and within countries, such as provinces or states, is the effect of country or state (province) characteristics on the outcome. I suggest using Hierarchical Linear Models (HLM) to examine these influences. Incorporating country and then province or state specific variables would yield additional information about fertility behavior. These variables include, but not limited to, Gross Domestic Product, prevalence of abortions or number of abortion clinics in the state, province income level, state unemployment rate, percent minority within the state or province, and mean education level of the state or province. These institutional factors indicate the level of modernization that the country or state/province has achieved. HLM would allow me to examine the relative impact of the individual level variables while controlling for the state/province and/or country level impact. In addition, I could examine the influence of the state/province and/or country level variance while controlling for individual level differences. I can further examine the effects of the state/province and/or country level on the slope of age at menarche.

Expanding this research to other countries, especially those with either very low fertility, such as Italy, and very high fertility, such as Afghanistan, would be beneficial for the continuation of this research. Because the Western European countries have completed the demographic transition for numerous years and all have below replacement level fertility, age at menarche may not apply to them. But if menarche is independent of social factors, as I have demonstrated, menarche should remain significant. In high fertility countries, the effect of menarche on fertility behavior should increase and be one of the most important variables because many of the countries that have yet to complete the demographic transition still rely on ceremonies and rites of passage to determine when their members are “ready” to transcend to the next phase of life. Menarche continues to be the “marker” in traditional societies.

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APPENDIX I

KAPLAN-MEIER SURVIVAL ESTIMATES

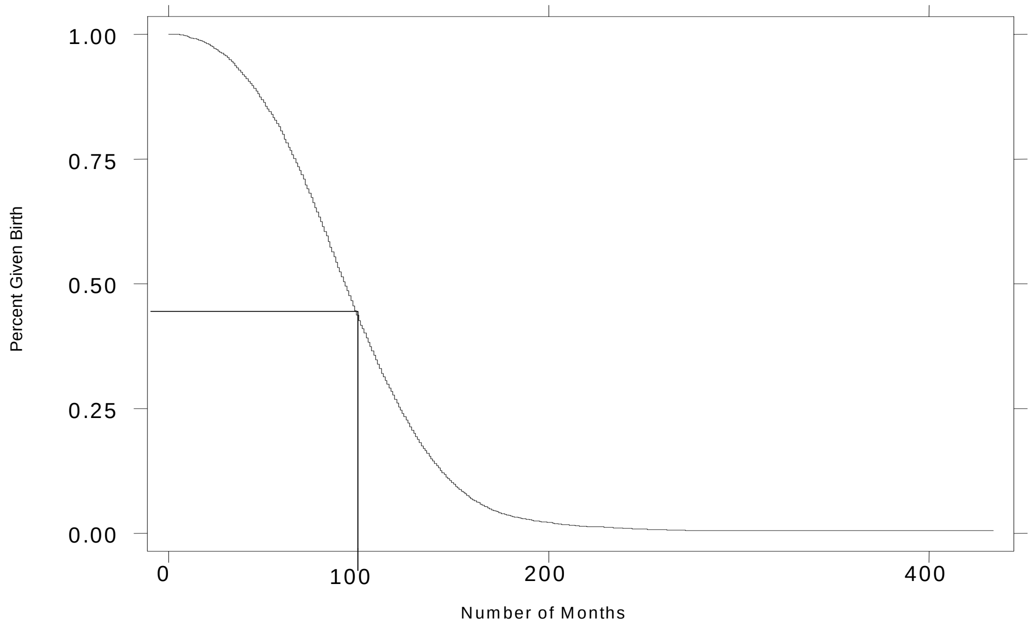

Figure 1: Kaplan-Meier Survival Estimates for the Hazard of a First Birth of Chinese Han Women, 1997

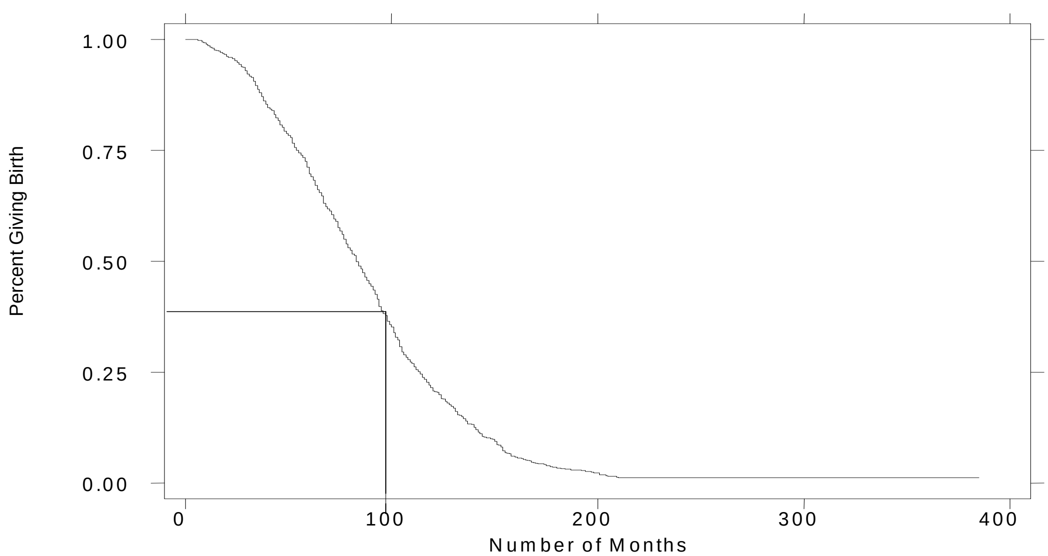

Figure 2: Kaplan-Meier Survival Estimates for the Hazard of a First Birth of Chinese Minority Women, 1997

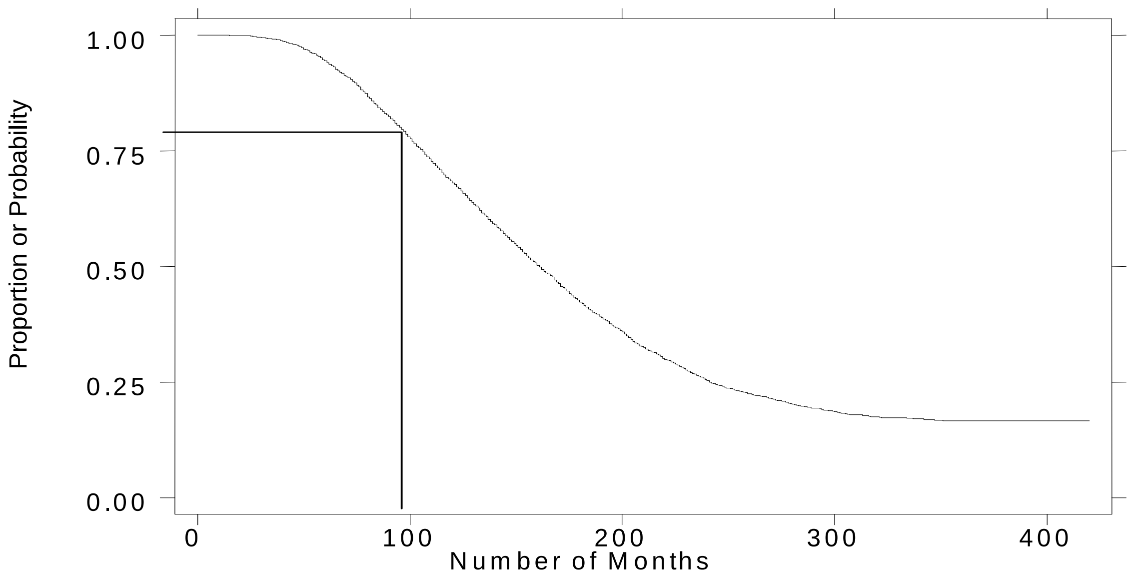

Figure 3: Kaplan-Meier Survival Estimates for the Hazard of a First Birth of U.S Non-Hispanic White Women, 1995

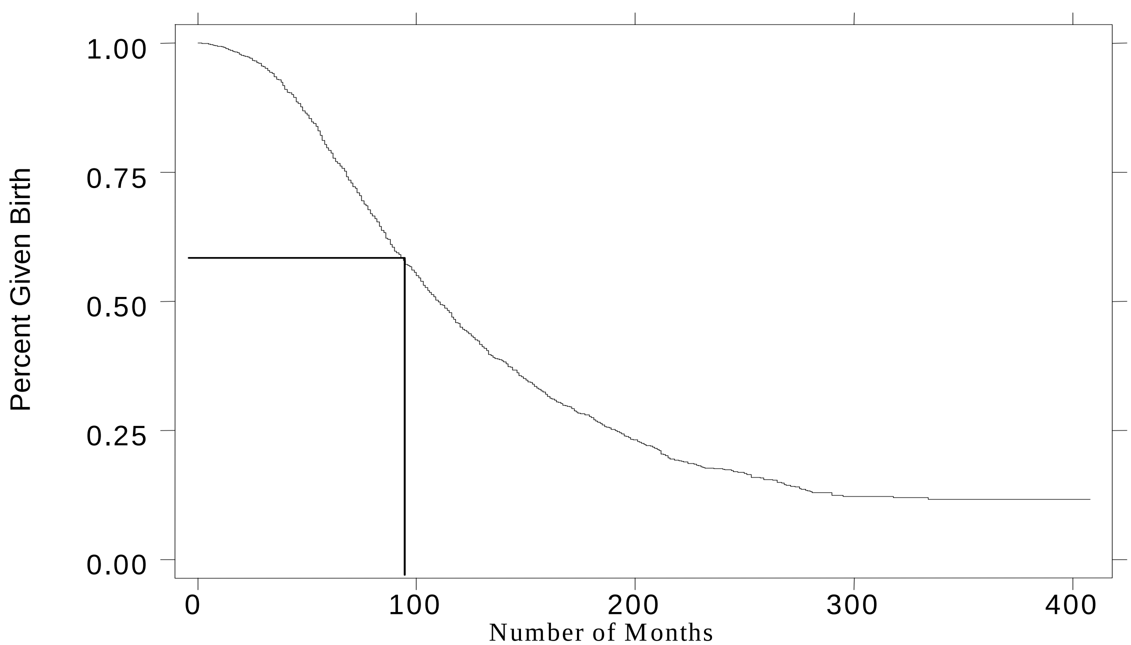

Figure 4: Kaplan-Meier Survival Estimates for the Hazard of a First Birth of U.S Non-HIspanic Black Women, 1995

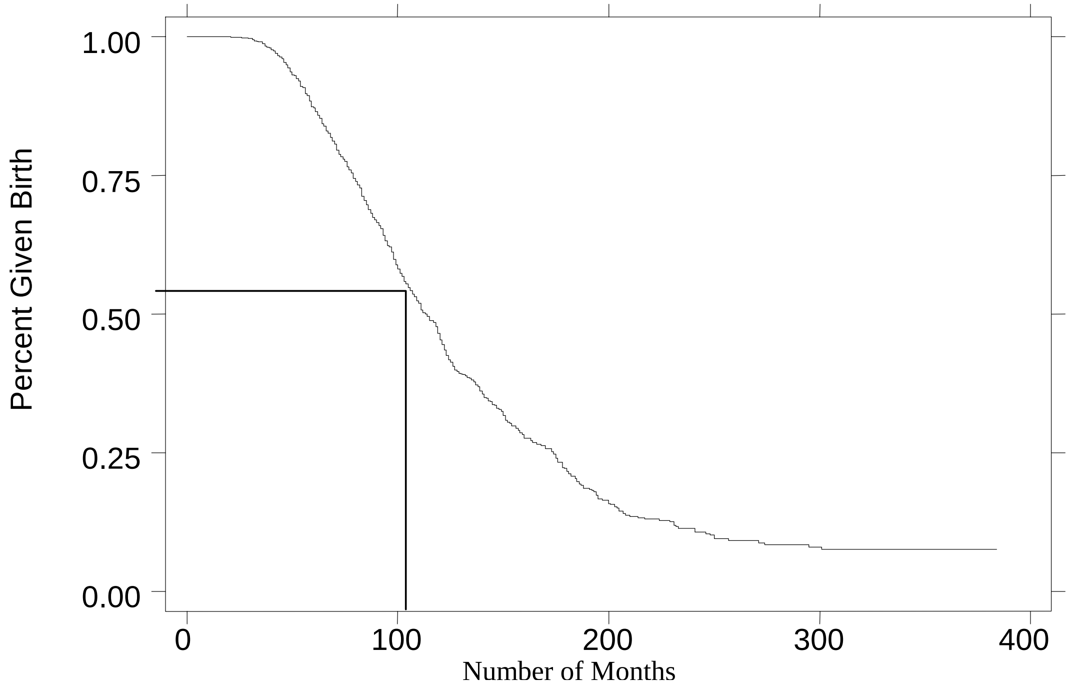

Figure 5: Kaplan-Meier Survival Estimates for the Hazard of a First Birth of U.S Mexican-Origin Women, 1995

APPENDIX II

DISTRIBUTION OF CEB AND UNIVARIATE POISSON

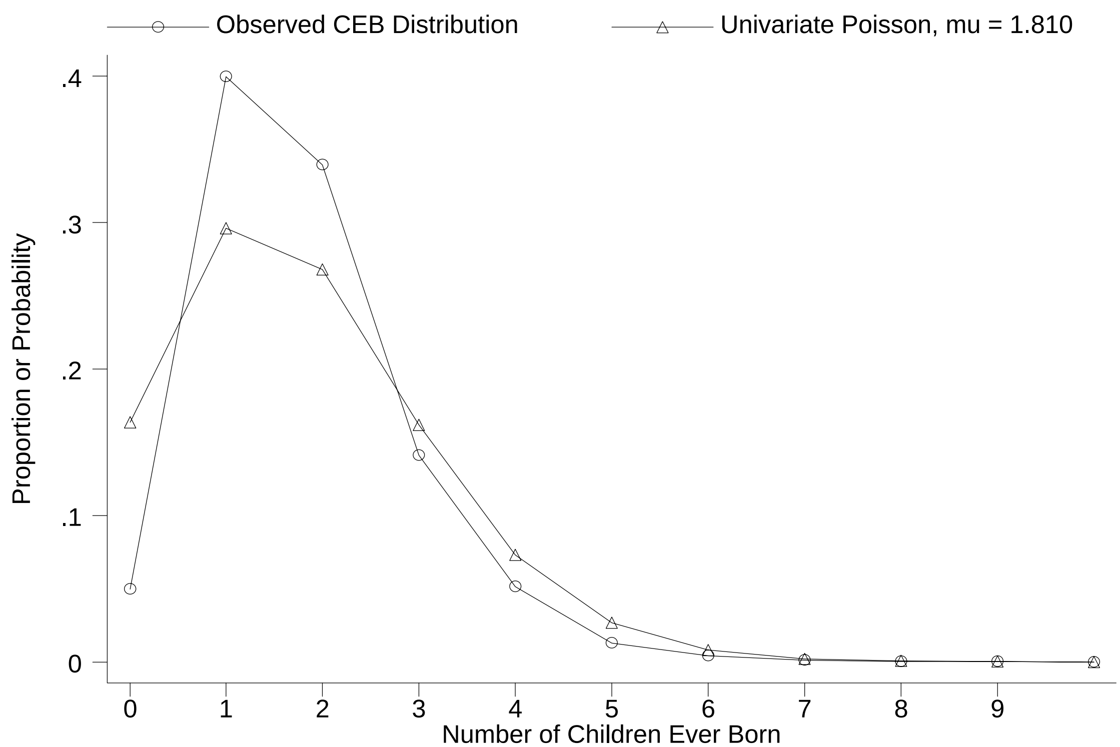

Figure 6: Distribution of CEB and Univariate Poisson for Chinese Han Women, 1997

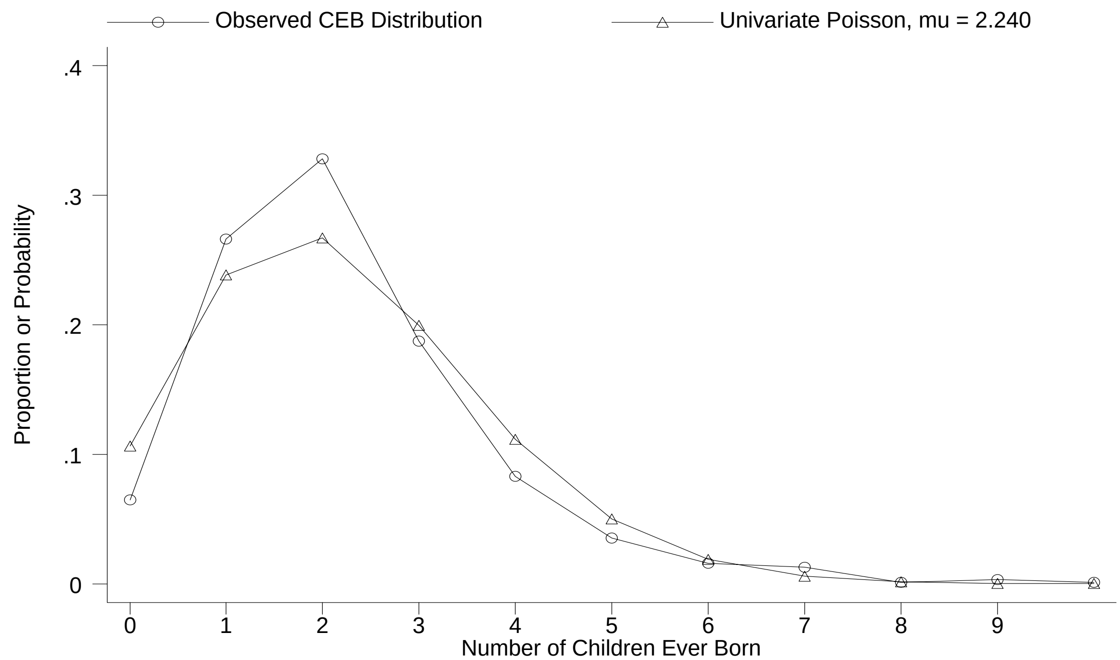

Figure 7: Distribution of CEB and Univariate Poisson for Chinese Minority Women, 1997

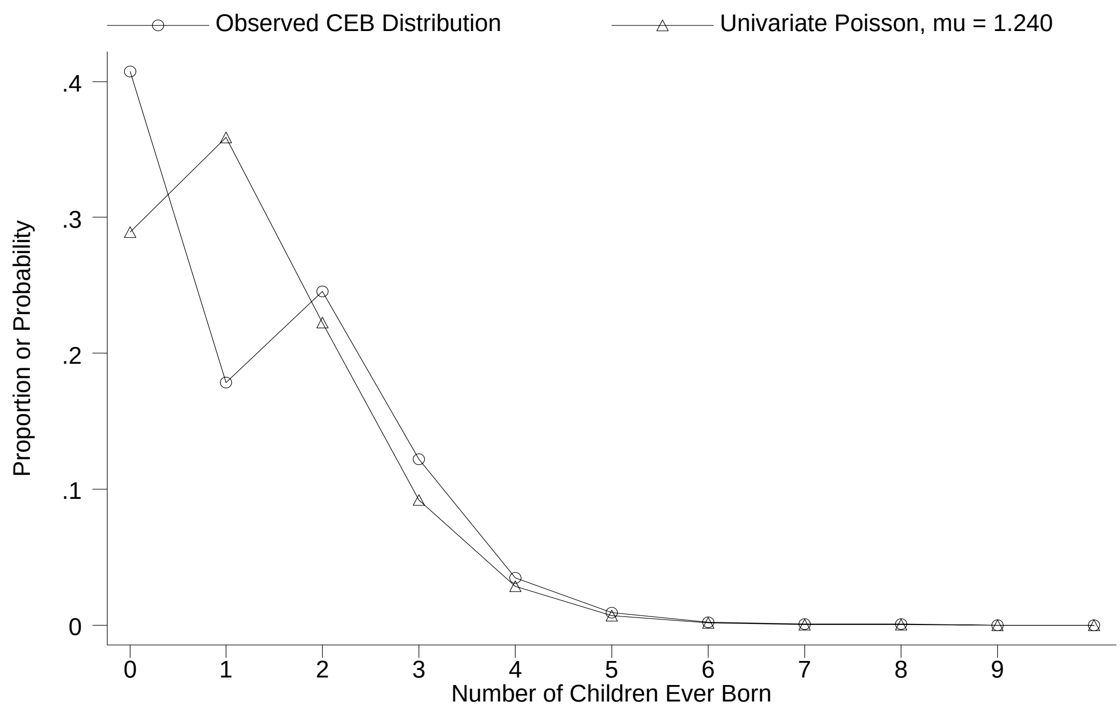

Figure 8: Distribution of CEB and Univariate Poisson for U.S. Non-Hispanic White Women, 1995

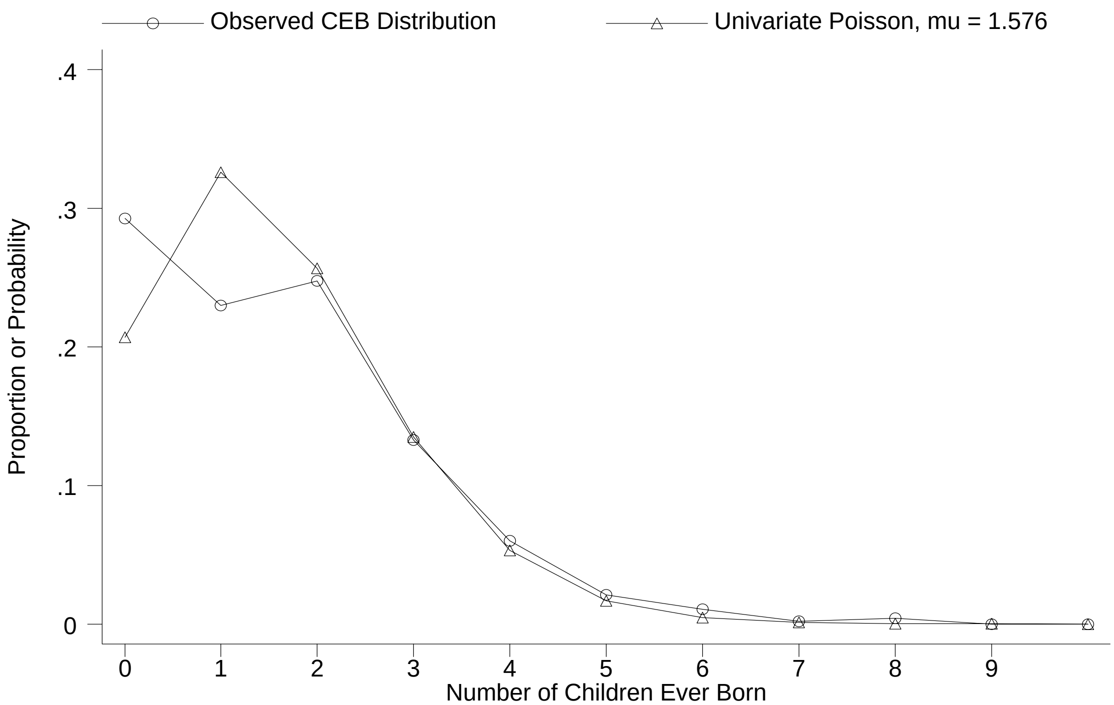

Figure 9: Distribution of CEB and Univariate Poisson for U.S. Non-Hispanic Black Women, 1995

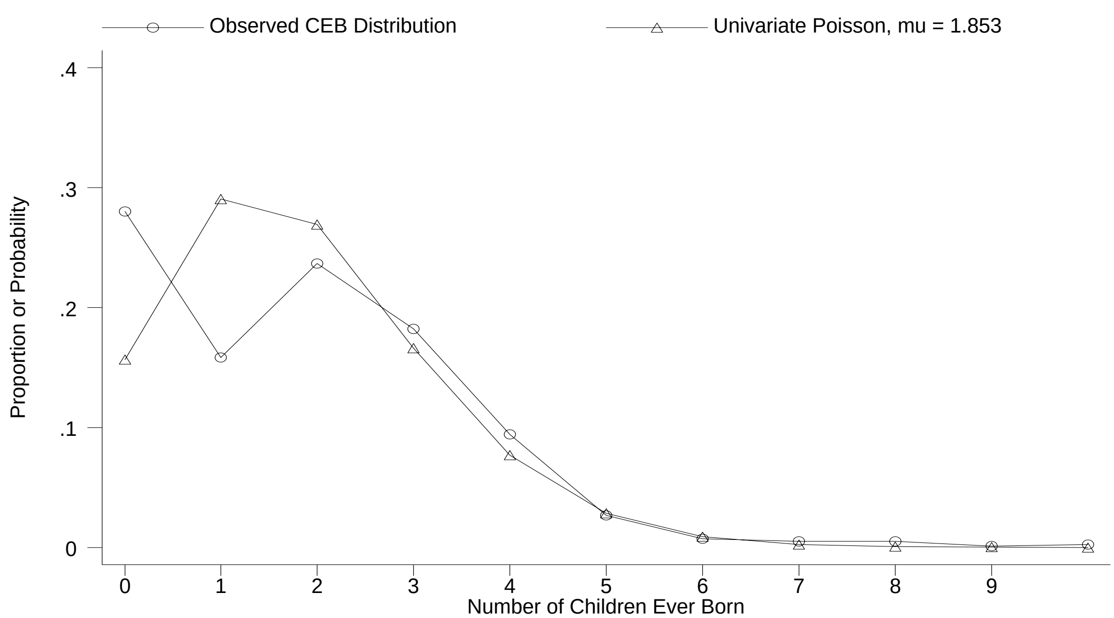

Figure 10: Distribution of CEB and Univariate Poisson for U.S. Mexican-Origin Women, 1995

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2004 McKibben, Sherry L.
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